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A Guide to the Interior Cedar - Hemlock Zone, Northwestern Transitional Subzone (ICHg), in the Prince Rupert Forest Region, British Columbia

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1 INTRODUCTION

The British Columbia Ministry of Forests is currently developing an ecosystem classification of the forest and range land of the province. Our classification is based, with some modifications, on the biogeoclimatic system developed over the past 30 years by Dr. V.J. Krajina and his students at the University of British Columbia. The system incorporates primarily climate, soil, and vegetation data. The resulting biogeoclimatic classification provides a framework for forest and range management, as well as for scientific research.

This guide briefly outlines the principles and methods of the classification system, stressing the two primary areas of emphasis within the classification, the biogeoclimatic (zones, subzones, variants) and the ecosystematic (ecosystem associations and their phases and variations). We summarize the environmental characteristics of the Northwestern transitional subzone of the Interior Cedar - Hemlock Zone (ICHg) and its five variants: ICHg1 - Upper Nass Basin variant; ICHg2 - Lower Nass Basin variant; ICHg3 - Hazelton variant; ICHg4 - Meziadin - Bell-Irving variant; and ICHg5 - Iskut - Stikine variant. The classification of the subzone at the ecosystematic level is then presented in detail.

An ecological classification can serve several purposes, depending on the needs and viewpoints of the users of the classification. The B.C. Ministry of Forests intends its classification to provide a context for scientific research and resource management, and to be used as a reference for scientists and resource managers responsible for maintaining or enhancing supplies of timber, forage, wildlife habitat, recreation, and water quantity and quality. All resources can be related to our ecosystem classification, but timber has priority within this ministry. Because of this priority, and also because of insufficient knowledge of other resources, we have developed primarily silvicultural interpretations, which are presented in the final section of the report. Use these prescriptions as a guide; they are not intended to be final or to be used in "cookbook" fashion. With time and increasing knowledge, we will amplify and modify the interpretations as required.

The area covered by this guide encompasses most of the lowland and mid-elevation forests of the western part of the Kispiox Timber Supply Area (TSA), and much of the northern Kalum TSA (see Figs. 1 and 5). Originally the study was to cover the now obsolete Skeena Public Sustained Yield Unit, but we extended the boundaries both to the north and the south.

We have included, in the pocket on the inside back cover, a map at 1:500 000 of the ICHg in the Prince Rupert Forest Region. Ultimately a map of all biogeoclimatic zones, subzones, and variants will be produced at a scale of 1:500 000 for the area covered by this report. The map will be similar to that produced by Klinka et al. (1979). Unfortunately we do not yet know enough of the study area (map sheets 93 NW, 103 NE, and 104 SE), especially at higher elevations, to make such a detailed map.

"A Guide to Some Common Plants of the Skeena Area, British Columbia" has been prepared (Coupé et al. 1982), and is designed to be used in conjunction with this guide to classification and interpretation. We have also produced a companion report entitled "A Guide to the Coastal Western Hemlock Zone, Northern Drier Maritime Subzone (CWHf) in the Prince Rupert Forest Region, British Columbia" (Haeussler et al. 1982). The CWHf guide is organized along the same lines as the ICHg guide, as both have evolved from the same original research project.

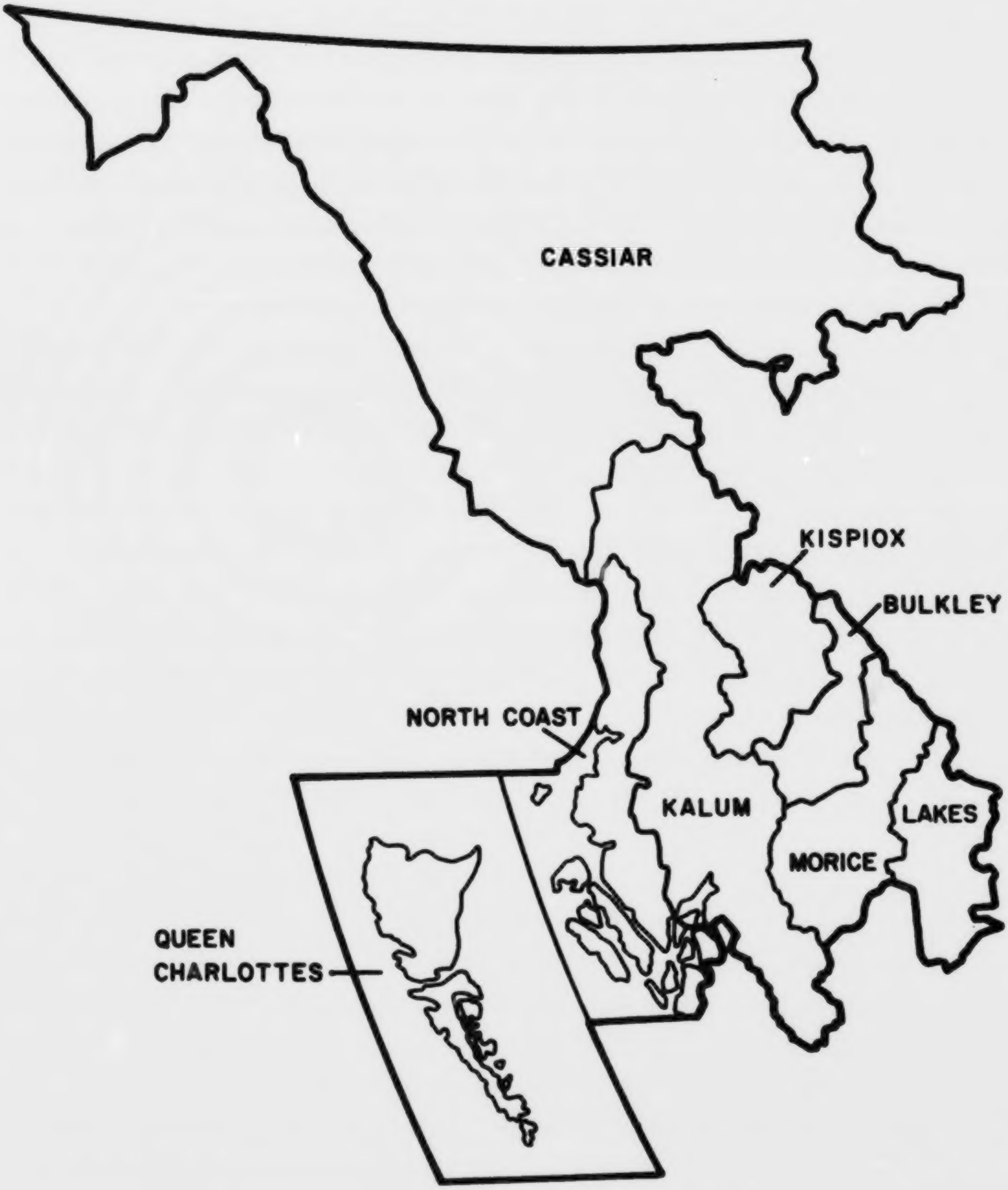
CASSIAR
KISPIOX
BULKLEY
NORTH COAST
KALUM
LAKES
MORICE
QUEEN CHARLOTTES

FIGURE 1. Timber Supply Areas of the Prince Rupert Forest Region, British Columbia.

2 OBJECTIVES

The goal of the ecosystem classification program is the improvement of forest management in British Columbia. The overall objective of the program is to provide resource managers with some of the information needed to meet the goal, by developing a "permanent", land-based, ecological classification to organize our knowledge of ecosystems and to serve as a framework within which to manage resources. In other words, the classification program aims to both organize and apply our knowledge of the structure, function, and relationships of forest and range ecosystems.

More specifically, this guide has five objectives:

1. Characterization, description, and mapping of the Interior Cedar - Hemlock Biogeoclimatic Zone, Northwestern transitional subzone (ICHg), in the Prince Rupert Forest Region;
2. Characterization and description of forest ecosystems in the ICHg;
3. Provision of aids in the identification of biogeoclimatic and ecosystematic units in the ICHg;
4. Development of preliminary silvicultural and forest management interpretations and recommendations relating to the ecosystem units of the ICHg;
5. Promotion of the concept of the ecosystem as the fundamental unit of forest management.

3 PRINCIPLES AND PHILOSOPHY

Numerous authors working in many different scientific fields have analysed and described the philosophy and methods of taxonomic classification. Some summaries pertinent to ecosystem classification are by Cline (1949), Whittaker (1962), Sokal (1974), Soil Survey Staff (1975), Bailey et al. (1978), Davis and Henderson (1978), and Pfister and Arno (1980). The biogeoclimatic system used by the Ministry of Forests is a classification of ecosystems (also called biogeocoenoses). It is being developed as a multi-level hierarchy with two primary sections or areas of emphasis: ecosystem or biogeocoenotic levels of integration, and biogeoclimatic or zonal levels (Fig. 2). Each section has several hierarchical taxonomic categories, as explained below in Sections 3.4 and 3.5.

3.1 Ecosystem

Ecosystem is the term used for the sum total of vegetation, animals, and physical environment in whatever size segment of the world is chosen for study (Fosberg 1967). Ecosystems are interacting complexes of living organisms (plants, fungi, bacteria, animals) and the physical environment (soil, air, water, bedrock) immediately affecting them. The ecosystem, as defined by Tansley (1935), has long served as the fundamental conceptual and functional unit of ecology. However, Tansley's concept of ecosystem is too broad to easily integrate into a formal classification. Therefore, Krajina (1960) proposed that Sukachev's biogeocoenose (Sukachev and Dylis 1964) for practical purposes best represents a basic ecosystem. A biogeocoenose is a special case of the ecosystem, but the two terms are used here interchangeably. Hence, for our purposes a terrestrial ecosystem (biogeocoenose) is a unit or portion of the landscape and the life on and in it. It is a landscape segment relatively uniform in the composition, structure, and properties of both the biotic and abiotic environments and in their interactions.

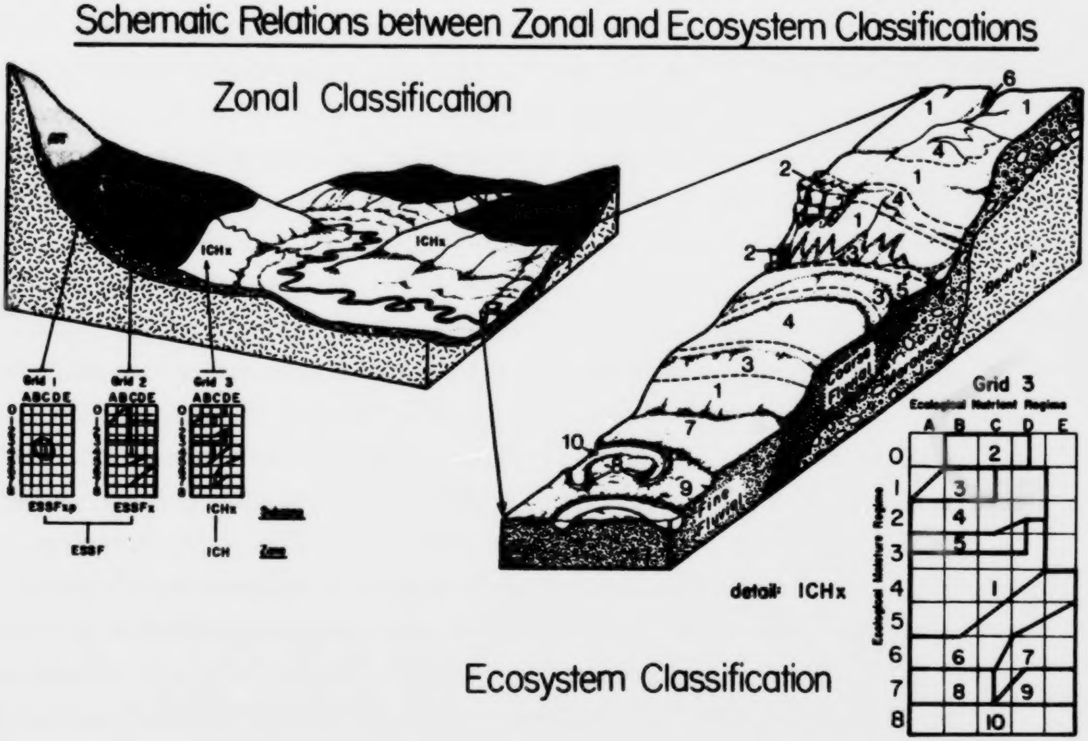
Schematic Relations between Zonal and Ecosystem Classifications
Zonal Classification
AT
ICHx
ICHx
Grid 1
Grid 2
Grid 3
ABCDE
ESSFxp
ESSFx
ICHx
Subzone
ESSF
ICH
Zone
Coarse Fluvial
Fine Fluvial
Bedrock
detail: ICHx
Ecosystem Classification
Grid 3
Ecological Nutrient Regime
A B C D E
Ecological Moisture Regime
0 1 2 3 4 5 6 7 8
1
2
3
4
5
6
7
8
9
10

FIGURE 2. Schematic relations between zonal and ecosystem levels of classification. AT = Alpine Tundra Zone; ESSFx and ESSFxp = hypothetical forested and parkland subzones, respectively, of the Engelmann Spruce - Subalpine Fir Zone; ICHx = a hypothetical subzone of the Interior Cedar - Hemlock Zone.

Numerous organisms such as fungi, earthworms, bacteria, insects, birds, and mammals are as much a part of the forest ecosystem as are trees, shrubs, herbs, and mosses. Furthermore, within the ecosystem there is a complex and dynamic set of relationships among these organisms and between them and their physical environment. However, for simplicity, the classification system deals primarily with two components of the ecosystem: vegetation and soil. The model of ecosystem function is that of Major (1951): vegetation and soils are products of climate, organisms, topography, parent material, and time. Plants and soil, considered simultaneously, integrate all ecosystem components and reflect ecosystem functioning. They are easy to observe and assess, and are considered to be the most convenient and suitable ecosystem features upon which to base the classification.

Thus, an ecosystem may be practically characterized by a "plant community" (a volume of relatively uniform vegetation) and the "soil polypedon" (a volume of relatively uniform soil) upon which the plant community occurs. An ecosystem has geographical bounds; its size is determined by the extent of the plant community and the associated soil polypedon. The latter boundaries may be abrupt, but more commonly they are gradual. As a result, an individual ecosystem usually contains some variation in biotic and abiotic characteristics.

3.2 Zonal Ecosystem

Climate is the fundamental determinant of the nature of terrestrial ecosystems. A classification of ecosystems should attempt to group related ecosystems influenced by the same mesoclimate. However, climate data are scant or lacking in some areas and climatic analysis alone will not produce an ecosystem classification. A reliable functional link between climate and ecosystems is needed. The concept of the zonal or climatic climax ecosystem provides this link.

The zonal ecosystem is that which best reflects the mesoclimate or regional climate of an area. The integrated influence of climate on the vegetation, soil, and other ecosystem components is most strongly expressed in those ecosystems least influenced by local relief or by physical and chemical properties of soil parent materials. Such ecosystems generally occur on gentle to moderate (5-35%) slopes, in positions that neither receive nor shed an excess of water and nutrients. They have normal exposure to solar energy (heat and light) and wind, and are not affected by localized cold air drainage. Zonal ecosystems have intermediate soil textures (broadly loamy), medium or mesic moisture regimes, and medium or mesotrophic nutrient regimes[1]. Soils usually are moderately pervious, deep (greater than 50 cm), and without root-restricting layers within the rooting zone. Hence, the biogeochemical cycles and energy exchange pathways of zonal ecosystems are more or less independent of local relief and soil parent material, and are in equilibrium with the regional climate.

Other ecosystems in a given area are influenced more strongly by local physiography and the physical and chemical properties of soil parent materials. They may be drier, wetter, richer, or poorer than zonal ecosystems, and they do not provide as clear a reflection of the regional climate.

Zonal ecosystems are characteristic of the regional climate that dominates their development. Hence, they are used to characterize biogeoclimatic units, which represent broad geographical areas of similar mesoclimate. The distribution of zonal ecosystems also determines the geographical extent of the biogeoclimatic units. Thus the concept of the zonal ecosystem links the ecosystematic and biogeoclimatic levels of classification (a zonal ecosystem labelled as "1", is indicated in Fig. 2).

3.3 Climax and Succession

3.3.1 Climax

The term "climax" in ecology refers to a condition of dynamic equilibrium, a steady state rather than a static endpoint. The species populations of a climax ecosystem should be in steady state, with a balance between recruitment and death of individuals. Similarly, overall ecosystem functions or attributes, such as productivity, biomass, soil organic matter, energy and nutrient budgets, should be in balance (Whittaker 1975). Hence, a climax ecosystem is, in theory, a stable, permanent occupant of the landscape -- self-perpetuating unless disturbed by outside forces or modifying factors. The living components of a climax ecosystem are in equilibrium with the prevailing factors of the physical environment and the member species are in dynamic balance with one another.

---

[1] Mesic and mesotrophic are qualitative, relative terms that represent different actual conditions in different zones (e.g., a mesic ecosystem in the Interior Cedar - Hemlock Zone is quantitatively wetter than a mesic ecosystem in the Sub-Boreal Spruce Zone). However, in all zones mesic and mesotrophic designate "average" or medium moisture and nutrient conditions, intermediate between the existing extremes of each zone.

In climax vegetation the species of plants are self-maintaining. Tree species of a climax forest are present as seedlings, saplings, and subcanopy and canopy trees. Similarly, climax shrubs, herbs, mosses, liverworts, and lichens are present in all stages from seedling or sporeling to maturity. In zonal forest ecosystems, only tree species that tolerate shade and intermediate moisture and nutrient conditions regenerate continually under the forest canopy.

3.3.2 Types of climax

Climatic climax ecosystems reflect the development potential of the prevailing regional climate. Other types of climax ecosystems occur where certain environmental factors have a greater influence on ecosystem development than does the regional climate. An edaphic climax differs from the climatic climax due to extreme soil or substrate conditions such as very coarse texture, high base saturation, or poor drainage. A topographic climax reflects compensating effects of topography on local climate (e.g., such as occur on a steep south slope). A topoedaphic climax occurs as a result of the combined influence of soil and topography (e.g., shallow, stony soil on a steep south slope). A fire climax may result from recurrent wildfire.

3.3.3 Succession

According to what has been termed the traditional view of succession (Drury and Nisbet 1973), ecosystems arrive at climax through a process of change called ecological succession, the progressive development of ecosystems through time. Sequential series of successional stages are called seres. There are several recognizable seral or successional stages in ecosystem development from, for example, an original bare surface to a mature forest. In theory, succession ends in a mature, climax ecosystem of relatively stable species composition and steady-state function, adapted to its environment and essentially permanent if undisturbed (Daubenmire 1968; Odum 1969; Whittaker 1975).

3.3.4 Climax and succession in the ICHg

The concepts of climax and succession have generated considerable controversy (for example, see Whittaker 1953; McIntosh 1967; Langford and Buell 1969; Drury and Nisbet 1973), much of it revolving around definitions, distinguishing criteria, structural and functional attributes, and the reality of both the climax state and the successional process. It would be inappropriate to discuss the controversy in this report, but it should be pointed out that we are following the traditional view of climax and succession in our ecosystem classification and, although many ecologists dispute this view, it provides useful insights and part of the philosophical basis of our treatment of the ecosystems of the ICHg.

Many ecosystems throughout North America and the world exist in successional states with little likelihood of ever attaining theoretical climax, because of the pervasive and persistent effects of disturbance. However, in northwestern North America, many forest ecosystems escape large-scale catastrophic destruction by fire, wind, and other agents (Parminter 1983; Brady and Hanley 1984). Succession may continue over centuries (Harris and Farr 1974; Waring and Franklin 1979; Henderson 1982), and large tracts of old forest occur throughout the region, including the ICHg. These forests can be termed old (most exceed 200 years in age), old-growth (in the sense of Franklin *et al*. 1981), uneven- or multi-aged, climax, decadent, over-mature, steady state, or dynamic equilibrium, depending on one's perspective. In any case, such forests (mostly *Tsuga heterophylla*[2] - dominated) occur in the ICHg, and they dominate the landscape of much of the study area.

This is not to say that climax forests are unchangeable or that all stands in similar environments are identical. Minor edaphic and climatic differences; differences in stand history in terms of past insect attacks, disease, windthrow, mass movements, fire, etc.; and chance factors all contribute to differences within a stand and from stand to stand on similar sites (Whittaker 1953). Fire, insects, and disease have all played major roles in the ICHg.

Although overall the ICHg is dominated by climax forests of western hemlock (*Tsuga heterophylla*) with lesser amounts of western red-cedar (*Thuja plicata*), subalpine fir (*Abies lasiocarpa*), and hybrid spruce (*Picea glauca* x *sitchensis* ?x *engelmannii*), there are extensive areas, especially at low elevations along the major rivers, dominated by seral ecosystems. Seral stands of trembling aspen (*Populus tremuloides*), paper birch (*Betul apapyrifera*), and lodgepole pine (*Pinus contorta*) are widespread as a result of natural and human-caused fire and land clearing. When such seral ecosystems are relatively old, yet remain distinct in form and function from climax (and we have sufficient samples), we have classified them into seral ecosystem associations, acknowledging that there is little likelihood they will ever reach theoretical climax.

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[2] Botanical nomenclature follows Coupé *et al*. (1982).

Sometimes, however, forests occur that theoretically are seral stages of a western hemlock climax, but are dominated by species such as subalpine fir and hybrid spruce that are moderately shade-tolerant. These stands appear capable of self-maintenance for at least several hundred years, and satisfy at least some of the criteria for climax. They probably owe their persistence to a localized sub-boreal type of climate that prevails because of cold air ponding on valley floors near the boundary between the Sub-Boreal Spruce Zone and the ICHg. We have treated such ecosystems as subassociations of the climax ecosystem association.

3.3.5 Potential climax and succession

British Columbia foresters will increasingly deal with seral ecosystems in the future, as older climax or near-climax stands are logged and replaced with young seral stands. Many of our management interpretations and recommendations are based on the expectation that if a disturbed (logged) forest is left alone it will gradually return to its natural state according to traditional successional theory. Whether this actually happens or not is uncertain, but nevertheless is largely an academic question because industrial forestry will maintain most productive ecosystems in seral states, probably less than 100 years old. Because our system classifies potential climax ecosystems, the classification will not become obsolete when managed seral forests prevail, _if_ logging-related disturbance is not excessive. The potential and limitations of a logged-over site remain similar to what was set out by the classification and interpretation of the original or potential climax ecosystem. Successional trends toward the climax can usually be identified even in young stands. We can still recognize, describe, and integrate the seral ecosystem into our classification, and can still make interpretations and predictions about the seral ecosystem throughout its succession towards harvestable age. Ecosystem classification thus provides a more or less permanent and ecologically-based system of land classification, with immediate and continuing application to management activities. In this report, we treat seral stages either as seral ecosystem associations or as ecosystem variations. With sufficient study, successional stages and pathways (which depend on stand history) could be described within each ecosystem unit, much as Arno (1982) and Steele (1984) have done within habitat types in Montana and Idaho. If more detail on seral ecosystems was required, a parallel classification, resulting in a greater array of seral ecosystem associations, could also be constructed.

3.4 Ecosystem Levels of Classification

Classification at ecosystematic (or biogeocoenotic) levels involves small areas relatively homogeneous in vegetation, soils, and implicitly in patterns of nutrient and energy dynamics, whereas classification at biogeoclimatic levels involves broad geographical areas of similar climate.

In this report, we use the ecosystematic categories of ecosystem association, subassociation, type, and seral ecosystem association. Phases and variations of ecosystem associations and subassociations are also recognized and used, although the phase and the variation are not formal categories in the classification. We will go into some detail in defining ecosystematic units, as they represent the levels of the classification within which most of the users of this report will be working.

3.4.1 Ecosystem type

An individual ecosystem consists of a plant community plus the soil polypedon upon which the community occurs. In the Interior Cedar - Hemlock Zone (ICH), the landscape is covered by numerous ecosystems of varying size, spread out over hill and valley. Most are forested; some are grassy, brushy, boggy, or have been recently cut or burned. Often the different ecosystems form a complex mosaic over the land, but their distribution is not random or helter- skelter. Similar plant communities recur in similar habitats, as do similar soil polypedons. The classification groups similar plant communities into "plant associations", and similar soil polypedons (in terms of humus form, horizons, texture, reaction [pH], parent materials, rooting depth, and coarse fragments) into "soil families". We define an "ecosystem type" as all ecosystems (land areas plus their biota) capable of producing vegetation belonging to the same climax plant association on soil of a single soil family. Although we have used the ecosystem type in constructing the classification, we do not define individual types in this report.

3.4.2 Ecosystem association

We then define the "ecosystem association" as all ecosystems capable of producing vegetation belonging to the same plant association at climax. Thus an ecosystem association is a group of related ecosystems physically and biologically similar enough that they have or would have similar vegetation at climax. The ecosystem association is similar to the habitat type of Daubenmire (1968) and Pfister *et al*. (1977).

We use the climax (or, where necessary, the advanced seral) condition to characterize ecosystem associations because we think that, as the culmination of ecological succession, the climax association best reflects the integration of environmental factors. One ecosystem association may include a variety of disturbance-induced, or seral, ecosystems, but succession will ultimately result in similar plant communities at climax throughout the association. Use of the climax plant association to name ecosystem associations does not imply that climax vegetation dominates the present landscape. Although overall the subzone is still dominated by old-growth, climax forest, many ecosystems in the ICHg (especially in the ICHg3 or Hazelton variant) reflect some form of disturbance and are in various stages of succession towards climax.

At this level of the classification we use the vegetation to define the taxon of ecosystem association. Although such an approach risks over-simplification, its utility validates it to some extent, as vegetation may be readily observed and described. Furthermore, plants integrate and reflect all other ecosystematic factors (climate, nutrient and water levels, time, etc.); vegetation is a product as well as a part of the environment.

For these reasons, and for brevity and familiarity, we label the ecosystem association with the name of the climax plant association. For example, in the ICHg1, there is the Tsuga heterophylla - (Vaccinium spp.) - Hylocomium splendens - Pleurozium schreberi - Ptilium crista-castrensis or "Zonal hemlock - moss" ecosystem association. Ideally, the name for this ecosystem unit would incorporate factors of physiography and soils, but that would be impractical, because an ecosystem association often occurs over a wide range of soil and landform characteristics. However, the occurrence of the same climax plant association over the range of site characteristics is an expression of the similar moisture and nutrient regimes shared by these sites. Thus the Zonal hemlock - moss ecosystem association signifies that group of ecosystems that occur 1) on moderately well to well-drained soils ranging from shallow to deep Podzols, Brunisols, and Folisols with Hemimor humus forms[3]; 2) on landforms ranging from morainal and colluvial blankets and veneers to organic (LFH) veneers over bedrock; and 3) on middle to lower, gentle to moderately steep slopes; all share more or less mesic and mesotrophic (intermediate for the subzone) moisture and nutrient regimes and supporting climax vegetation characterized by the Tsuga - (Vaccinium spp.) - Hylocomium - Pleurozium - Ptilium plant association. Providing the classification is adequately described, explained, and understood, a relatively simple name can convey a great deal of useful information about individual ecosystems in the field.

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[3] Humus form (forest floor) terminology after Klinka et al. (1981).

3.4.3 Ecosystem subassociation

The goal of our classification is to describe adequately the natural variation of the forests of British Columbia, and to classify this variation in a way that is not only scientifically accurate and defensible, but is as simple as possible and also allows and encourages practical applications. Classification at the ecosystem association level accounts for and describes the major variation in species composition and moisture/nutrient regimes within a given biogeoclimatic subzone or variant. Among the climax ecosystems making up associations, however, there often occurs recognizable variation in the relative abundance of one or more species that appears to reflect environmental differences, and is worthy of a place in the classification. We have defined a taxonomic sub-division of the ecosystem association, the "ecosystem subassociation", to describe these differences in species composition that appear to reflect trends in local climatic, edaphic or very long-term successional factors, but which are not considered significant or distinct enough (based on present data) to warrant the recognition of a distinct ecosystem association.

For example, in the ICHg3 variant two subassociations of the zonal hemlock - moss ecosystem association (ICHg3/01) are recognized based on the relative dominance of western hemlock and western redcedar versus subalpine fir and hybrid spruce in the overstory. The Hemlock - (cedar) subassociation (ICHg3/01.1) is dominated by western hemlock and to a lesser extent by western redcedar, with infrequent subalpine fir and hybrid spruce. Conversely the Subalpine fir - spruce subassociation (ICHg3/01.2) is dominated by subalpine fir and hybrid spruce, and apparently represents "pseudoclimax" stands that will maintain themselves (because most regeneration is subalpine fir and hybrid spruce rather than western hemlock and redcedar) for at least 100 years. Even though they are the most shade-tolerant species in the variant, it appears that hemlock and cedar will very slowly gain ascendancy, because a localized sub-boreal-like climate prevails in certain valley-bottom parts of the ICHg3 (e.g., vicinity of Kispiox, Moricetown, Trout Creek valley). It seems that in these transitional areas close to the boundary between the ICHg and the Sub-Boreal Spruce Zone, reproduction of shade-tolerant trees is sensitive to relatively slight variations in local climate, with the consequence that climax ecosystems may be dominated either by hemlock and cedar, or subalpine fir and spruce. With more study, these areas of cold-air ponding could perhaps be delimited as biogeoclimatic phases of the ICHg3.

3.4.4 Seral ecosystem association

The category of seral ecosystem association was created to accommodate disclimax ecosystems. A disclimax exists when an apparently seral (non-climax) community, dominated by shade-intolerant species, is perpetuated by continuous or intermittent disturbance. Disclimax ecosystems are widespread in the ICHg, particularly in the Hazelton region where stands of lodgepole pine, trembling aspen, paper birch, hybrid spruce, and subalpine fir have been established and maintained by fire for such long periods of time that they have altered the nature of the soil and virtually excluded western hemlock from many areas.

It is true that a shade-tolerant, hemlock-dominated climax would eventually develop if natural fires, beetle infestations, and other forms of disturbance were prevented. However, long-term lack of disturbance would be an artificial condition, and spruce and subalpine fir would still be dominant tree species for several generations before giving way to hemlock and cedar.

It would be unrealistic to impose a classification based solely on shade-tolerant climax ecosystems on a subzone like the ICHg, where a significant portion of both managed and unmanaged stands will not even approach a climax condition within a reasonable time. Seral ecosystem associations have significantly different vegetation and physical site properties from climax ecosystem associations and thus create different opportunities and problems for forest managers.

3.4.5 Ecosystem association phase

Sometimes the ecosystem association, which is a fundamental theoretical unit in the classification, may also be the operational unit upon which to base silvicultural and other management decisions. However, in many cases the ecosystem association must be subdivided into more operationally significant units. This is especially true of those widespread ecosystem associations that encompass quite a range of habitat conditions.

The "ecosystem association phase" (or ecosystem phase for short) is used for better site differentiation and identification. The "ecosystem phase" is basically a functional subdivision of the ecosystem association and recognizes some edaphic property or attribute that may be useful or significant to the users of the classification. For example, the ICHg3/09 or Spruce - pine - shrub seral ecosystem association has two phases, coarse textured and fine textured, in recognition of two general particle-size classes that are correlated with differences in ecosystem moisture, nutrients, and tree growth. Delimitation of the two phases gives more meaning to silvicultural interpretations of the widespread seral associations. Other ecosystem phases might be based on slope classes, aspect, soil climate, bedrock type, or some other useful feature of the soil or landform. The ecosystem phase thus reflects variation contained within ecosystem associations, and allows differentiation of recognizable and repeatable subunits of the ecosystem association for management, silvicultural, or purely descriptive purposes.

3.4.6 Ecosystem association variation

We use the "ecosystem association variation" (or "ecosystem variation" for short) to accommodate slight vegetative deviations from the central concept of the ecosystem association, or to describe some widespread successional stages of the climax association. In part because our classification relies on climax ecosystems, this type of variability does not yet have a place in the formal classification. However, it is important to recognize and describe such variation in species composition, so as to aid in the identification and interpretation of ecosystems in the field.

The *Vaccinium* variation of the ICHgl/01 is an example of a vegetative deviation from the central concept of the ecosystem association. The *Vaccinium* variation is more or less identical to typical ICHgl/01, except for the presence of a characteristic, well-developed, *Vaccinium*-dominated shrub layer.

Seral ecosystems are common in the ICHg. We use variations to label and describe seral stands that already bear a strong relationship to the climax stand into which they will (it appears) eventually develop. Such stands can usually be easily assigned to the appropriate climax ecosystem association.

However, when seral stands are relatively old (greater than 100 years in age) but have not yet attained or even approached theoretical climax, we recognize seral ecosystem associations rather than variations. It appears that such stands will very probably never reach climax in the prevailing disturbance regime, in which the average return period of major disturbance is less than 100 years. For example, it appears that flooding occurs frequently enough to maintain cottonwood ecosystems as long as there is an active floodplain, so they are grouped in a seral ecosystem association rather than as a variation of a (theoretical climax) spruce floodplain association.

3.5 Biogeoclimatic Levels of Classification

The biogeoclimatic area of emphasis provides higher categories in the taxonomic hierarchy to accommodate further generalization of ecosystem units, based mainly on climatic relationships. Classification, characterization, and mapping of biogeoclimatic units are the major activities carried out at these levels. Biogeoclimatic units or categories commonly used by the Ministry of Forests are the zone, subzone, and variant. In addition, phases are recognized and used, but the phase is not a formal category in the classification.

3.5.1 Biogeoclimatic subzone

A distinct climatic climax or zonal ecosystem association characterizes a "subzone". A subzone thus consists of unique sequences of geographically related ecosystems in which climatic climax ecosystems are members of the same zonal ecosystem association. Such sequences are influenced by one type of regional climate. Subzones are the basic units of biogeoclimatic classification, and are the first to be recognized in the classification process. Note that the two sections of the classification are linked through the fundamental relationship between the zonal ecosystem association and the subzone.

This report deals primarily with one subzone of the Interior Cedar - Hemlock Zone, the ICHg or Northwestern transitional subzone.

3.5.2 Biogeoclimatic variant

Subzones also contain considerable variation, for which we have provided the biogeoclimatic category of "variant". Variants reflect further differences in regional climate, and are generally recognized for areas that are drier, wetter, snowier, warmer, or colder than other areas in the subzone. These climatic differences result in corresponding differences in vegetation, soil, and ecosystem productivity. The differences in vegetation may be expressed as changes in the proportion and vigour of certain plant species, or differences in successional development or in the overall pattern of vegetation over the landscape. Differences in soils may be confined to the variation in intensity of certain soil-forming processes and not be markedly expressed in morphological features. Thus, variants are characterized by a distinct zonal ecosystem association plus a supplementary combination of environmental factors.

In this report on the Northwestern transitional subzone, we have recognized five distinct biogeoclimatic variants, designated ICHg1,2,3,4, and 5. Characteristic features of and differences among the variants are described in detail in Section 6.

3.5.3 Biogeoclimatic phase

The "biogeoclimatic phase" accommodates variation, resulting from local relief, in the regional climate of subzones and variants. Phases are useful in designating significant, extensive areas of ecosystems that are, for topographic or topoedaphic reasons, atypical for the regional climate. Examples might be extensive areas of grassland occurring only on steep, south slopes in an otherwise forested subzone; enclaves of apparently coastal forest on moist, northeastern slopes in an interior subzone (e.g., ICHg1a or Amabilis fir phase); or valley-bottom, frost-pocket areas in mountainous terrain (as occur in the ICHg3). The biogeoclimatic phase relates to local climate and hence is not a formal category in the classification, but phases can be identified and mapped for management or descriptive purposes.

The only biogeoclimatic phase we describe in this report is the ICHg1a or Amabilis fir phase. However, other areas with atypical local climate certainly exist within the subzone and may be recognized as special phases when we have more data to describe them.

3.5.4 Biogeoclimatic zone

We group subzones with affinities in climatic characteristics and zonal ecosystems into zones. We define a biogeoclimatic zone as a large geographic area with a broadly homogeneous mesoclimate. Consequently a zone has characteristic webs of energy flow and nutrient cycling, and typical patterns of vegetation and soil. We characterize zones by closely related, zonal ecosystem associations. Zones also have characteristic, prevailing soil-forming processes, and one or more typical, major, climax species of tree, shrub, herb, and/or moss. Zones are usually named by one or more of the dominant shade-tolerant tree species (the Alpine Tundra Zone is a self-explanatory exception) capable of self-regeneration in zonal ecosystems; a geographical modifier is often added to the name.

4 METHODS

Field procedures of the Ministry of Forests' classification program follow those outlined in detail in the manual by Walmsley et al. (1980). Analytic and synthetic methods have been described by Klinka et al. (1977[4], 1979), and are similar to those of Krajina and his students (e.g., Brooke et al. 1970; Wali and Krajina 1973; Kojima and Krajina 1975). However it seems that our methods are still not well understood and need further explanation.

4.1 Plot Sampling

Field sampling is stratified on the basis of biogeoclimatic units and ecological moisture and nutrient regimes. Based on reconnaissance and other available information, tentative biogeoclimatic units are often delineated prior to plot selection. An edatopic grid (Fig. 3) is used as an aid to stratification within each biogeoclimatic unit. We try to sample five or more plots representing each of the possible combinations of moisture and nutrients. Intensity of sampling varies according to the areal extent of the ecosystem, its apparent diversity, and its importance for forestry or range management. Sampling intensity also depends on available access, and on the nature and scale of the project.

We sample selectively. Sample plots are located in habitats that are as uniform as possible; heterogeneous, transitional, or disturbed sites are avoided. To date, most sampling has been confined to climax or near-climax ecosystems. Plots are located so as to represent particular combinations of moisture and nutrients (see Tables 1 and 2). Slope position, indicator plant species, relative tree growth, soil texture, seepage, and base status of parent materials, among other things, are used as clues to moisture and nutrient regimes. The professional judgement of experienced fieldworkers in selecting representative ecosystems is an important part of our approach.

The smallest unit of sampling in ecosystem studies is the "sample plot" (also termed 'sample plot' by Mueller-Dombois and Ellenberg

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[4] Klinka, K., J.P. Kimmins, J.T. Standish, and J. Phelps. 1977. Initial data synthesis in the synecological classification. Unpublished manuscript. B.C. Min. For., Victoria, B.C.

ECOLOGICAL MOISTURE REGIME		ECOLOGICAL NUTRIENT REGIME OLIGO-TROPHIC A	SUBMESO-TROPHIC B	MESO-TROPHIC C	PERMESO-TROPHIC D	SUBEUTROPHIC TO EUTROPHIC E
VERY XERIC	0					
XERIC	1					
SUBXERIC	2					
SUBMESIC	3					
MESIC	4					
SUBHYGRIC	5					
HYGRIC	6					
SUBHYDRIC	7					

FIGURE 3. Edatopic grid of ecological moisture and nutrient regimes.

TABLE 1. Ecological moisture regime classes[1]

	DEFINING CHARACTERISTICS		FIELD RECOGNITION CHARACTERISTICS						
				Soil properties					
Moisture regime	Description	Primary water source	Slope position	Texture	Drainage	Depth to impermeable layer	Surface humus depth	Available water stor. cap.	Slope gradient
VERY XERIC	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after ppt.	precipitation	ridge crests shedding	very coarse (gravelly-s) abundant coarse fragments	very rapid	very shallow (< 0.5 m)	very shallow	extremely low	very steep (especially on south aspects)
XERIC	Water removed very rapidly in relation to supply; soil is moist for brief periods following ppt.	precipitation			rapid				
SUBXERIC	Water removed rapidly in relation to supply; soil is moist for short periods following ppt.	precipitation	upper slopes shedding	coarse to mod. coarse (LS-SL) mod. coarse fragments				very low	
SUBMESIC	Water removed easily in relation to supply; water available for moderate short periods following ppt.	precipitation			rapid to good	shallow (< 1 m)	shallow	low	steep moderate
MESIC	Water removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year. Available soil moisture reflects climatic inputs.	precipitation in moderately to fine-textured soils and limited seepage in coarse textured soils	mid-slope normal rolling to flat	moderate to fine (L-SiL) few coarse fragments	good to moderately good	moderately deep (1–2 m)	moderately deep	moderate	
SUBHYGRIC	Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm.	precipitation and seepage	lower slopes receiving	variable depending on seepage	moderately good to imperfect	deep (> 2 m)	deep	high	slight
HYGRIC	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying.	seepage			imperfect to poor	variable depending on seepage		variable depending on seepage	
SUBHYDRIC	Water removed slowly enough to keep the water table at or near the surface for most of the year; gleyed mineral or organic soils; permanent seepage less than 30 cm below the surface.	seepage or permanent water table			poor to very poor		very deep		
HYDRIC	Water removed so slowly that the water table is at or above the soil surface all year; gleyed mineral or organic soils.	permanent water table	depressions receiving	variable depending on seepage	very poor	variable depending on seepage		variable depending on seepage	flat

[1] From Walmsley *et al.* (1980).

TABLE 2. Ecological nutrient regime characteristics[1]

	Oligotrophic A	Submesotrophic B	Mesotrophic C	Permesotrophic D	Eutrophic E	Hypereutrophic F
Definition	very poor nutritional status, very small supply of available nutrients	poor nutritional status, low supply of available nutrients	medium nutritional status, medium supply of available nutrients	rich nutritional status, plentiful supply of available nutrients	very rich nutritional status, abundant supply of nutrients	saline nutritional status, excess salt accumulations
BEDROCK SOURCE	granite	granodiorite	diorite	gabbro	peridotite	dunite -- serpentine
	rhyolite	dacite	andesite	basalt		
	quartzite	quartz gneiss	garnet schist	biotite schist -- slate	phyllite	marble
	quartz sandstone	conglomerate	graywacke	argillite - shale - dolomite	limestone	gypsym -- halite
TEXTURE	very coarse	coarse	medium	fine	very fine	variable
ORGANIC MATTER CONTENT	low	moderate		high		variable
HUMUS FORM	acid mors	mors and moders		moders and mulls		
SOIL REACTION	extremely acid to medium acid	medium acid to neutral		slightly acid to mildly alkaline		moderately to strongly alkaline
CATION EXCHANGE CAPACITY	low		moderate	high		variable
BASE SATURATION	low		moderate	high		variable
C/N RATIO	high		moderate	low		variable

[1] From Walmsley *et al.* (1980). Note that the presence of nutrient-rich seepage waters may compensate for other factors to create eutrophic conditions.

(1974)for vegetation sampling, and termed 'pedon' by Soil Survey Staff (1975) for soil sampling). Plot size in forest stands is usually 400-500 m^2; plot shape is variable but usually square or rectangular. At each site, the standardized provincial site, soil, humus form, vegetation, and mensuration data sheets are completed, according to the procedures in Walmsley _et_ _al_. (1980).

4.2 Analysis

The information collected from the sample plots must be analysed and integrated into a usable classification. To accomplish this we code vegetation and selected soil, physical, and mensurational data for tabulation by a computer program developed by Klinka and Phelps (Klinka _et al_. 1977[5]). The program sorts, organizes, and presents these data; it does not perform any classification. This procedure aids in the traditional Braun-Blanquet method of classification by tabular analysis (see Mueller-Dombois and Ellenberg 1974), mainly by reducing manual procedures and transcription errors.

The program produces environment, vegetation, and vegetation summary tables. The classifier specifies the tentative ecosystem units, relying to a large extent on personal knowledge and judgement. The program summarizes environment and vegetation data according to the specified units. The summary vegetation table then presents species presence (frequency of occurrence in sample plots) and mean species significance (an estimate of both cover and abundance) for all plant species in all differentiated units. Successive rearrangements can be easily made.

The classifier generally groups plots by tentative biogeoclimatic unit and by estimated moisture/nutrient regime. The vegetation tables list species by stratum or layer (trees, shrubs, herbs, etc.) in order of presence and mean percent cover for each ecosystem unit. Plots or groups of plots that are floristically different may be separated or moved to another group. Plots that appear similar in moisture and nutrient regime are experimentally merged. Through this process of computer-assisted, experimental grouping, rearrangement, and refining of groups, the ecosystem associations are defined (cf. Poore 1962). Ecosystem associations may then be subdivided into subassociations, types, variations, or phases, often on the basis of edaphic factors as summarized by the environment tables. The degree of lumping or splitting among ecosystem units is largely a matter of personal judgement or, in the case of phases, of operational significance.

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[5] Ibid.

Zonal ecosystem associations characterize individual subzones. Subzones which are more similar to each other than they are to any other subzones are then grouped into biogeoclimatic zones. This last taxonomic decision has to date been largely subjective, based on the classifiers' concepts of mesoclimate, zonal ecosystem associations, allowable variation within a zone, and the precedent of Krajina (1965, 1973, 1979).

The Ministry of Forests has so far done little mathematical treatment of the data collected and summarized by the ecosystem classification program. However, there are plans for using ordination and other numerical techniques in the near future.

4.3 Mapping

Biogeoclimatic mapping begins with a review of available ecosystem classifications within or near the mapping area. Biogeoclimatic units are characterized and summarized in synopsis form. A draft map, based on physiography and the extrapolation of elevational limits, may be prepared. Field mapping is done along selected transects by ground and air survey. The ground survey includes brief descriptions (rapid reconnaissance) of vegetation and soils; special attention is paid to zonal ecosystems. Boundaries drawn in the field are based on the type and occurrence of zonal ecosystems, floristic combinations, and the distribution of azonal, edaphic climax ecosystems. Final boundaries are drawn after fieldwork and data analysis have been completed. Boundaries outside transects are extrapolated on the basis of elevation and physiography.

5 GENERAL CHARACTERISTICS OF THE SUBZONE

5.1 Geographic Description

The Interior Cedar - Hemlock Biogeoclimatic Zone (ICH) in the Prince Rupert Forest Region consists of one subzone, the ICHg or Northwestern transitional subzone. Other subzones of the ICH are located in the "Interior wet belt" of southeastern British Columbia.

The ICHg lies just east of the Coast Mountains in the drainages of the Skeena, Nass, Iskut, and Stikine rivers. It encompasses most of the Nass Basin physiographic subdivision and adjacent parts of the Skeena and Hazelton Mountains (Holland 1976). Valley floors and lower to mid-mountain slopes ranging in elevation from 100 m to 1000 m are included within the ICHg. To the west, the ICHg is bounded by subzones of the Coastal Western Hemlock Zone (CWH); to the east it borders on the Sub-Boreal Spruce Zone (SBS). The Engelmann Spruce - Subalpine Fir Zone (ESSF) lies at subalpine elevations above the ICHg. Figures 4 and 5 show the location of the ICHg in the Prince Rupert Forest Region.

5.2 Climate (Wilson and Marsh 1975[6]; Environment Canada 1980)

The climate of the ICHg (see Fig. 6) is intermediate between the cool, wet, more equable conditions of the North Coast and the drier, more extreme conditions of the Interior Plateau. In west central British Columbia, weather systems generally originate off the Pacific Coast and move inland. As warm, moisture-laden, coastal air masses rise over the Coast Mountains they are abruptly cooled and deposit most of the moisture on the windward (west-facing) mountain slopes. By the time these air masses reach the interior or leeward side of the mountains, they are quite dry and susceptible to cooling or warming by the land surface. Where wide valleys such as the Skeena and the Nass cut through the Coast ranges the warm humid air is able to penetrate much further inland, losing its warmth

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[6] Wilson, R.G. and R.D. Marsh. 1975. Climatic constraints to logging and climatic suitability for recreation in the Terrace-Hazelton forest resources study area. Unpublished report. B.C. Min. Environ., Climate and Data Serv. Div., Victoria, B.C.

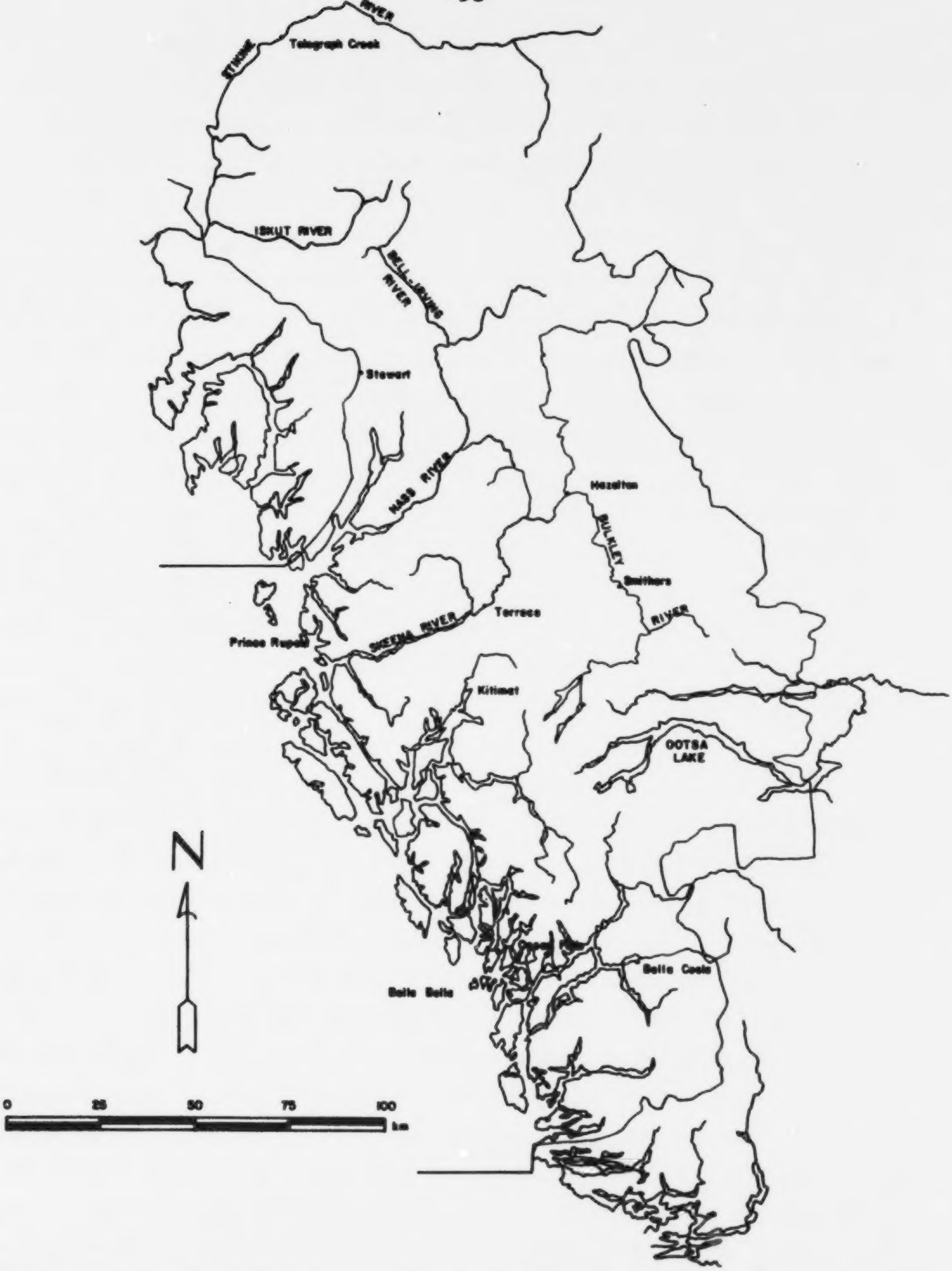

STIKINE
RIVER
Telegraph Creek
ISKUT RIVER
BELL-IRVING
RIVER
Stewart
NASS RIVER
Hazelton
BULKLEY
Smithers
RIVER
Terrace
SKEENA RIVER
Prince Rupert
Kitimat
OOTSA
LAKE
Bella Coola
Bella Bella
N
0
25
50
75
100
km

FIGURE 4. Base map of central part of the Prince Rupert Forest Region.

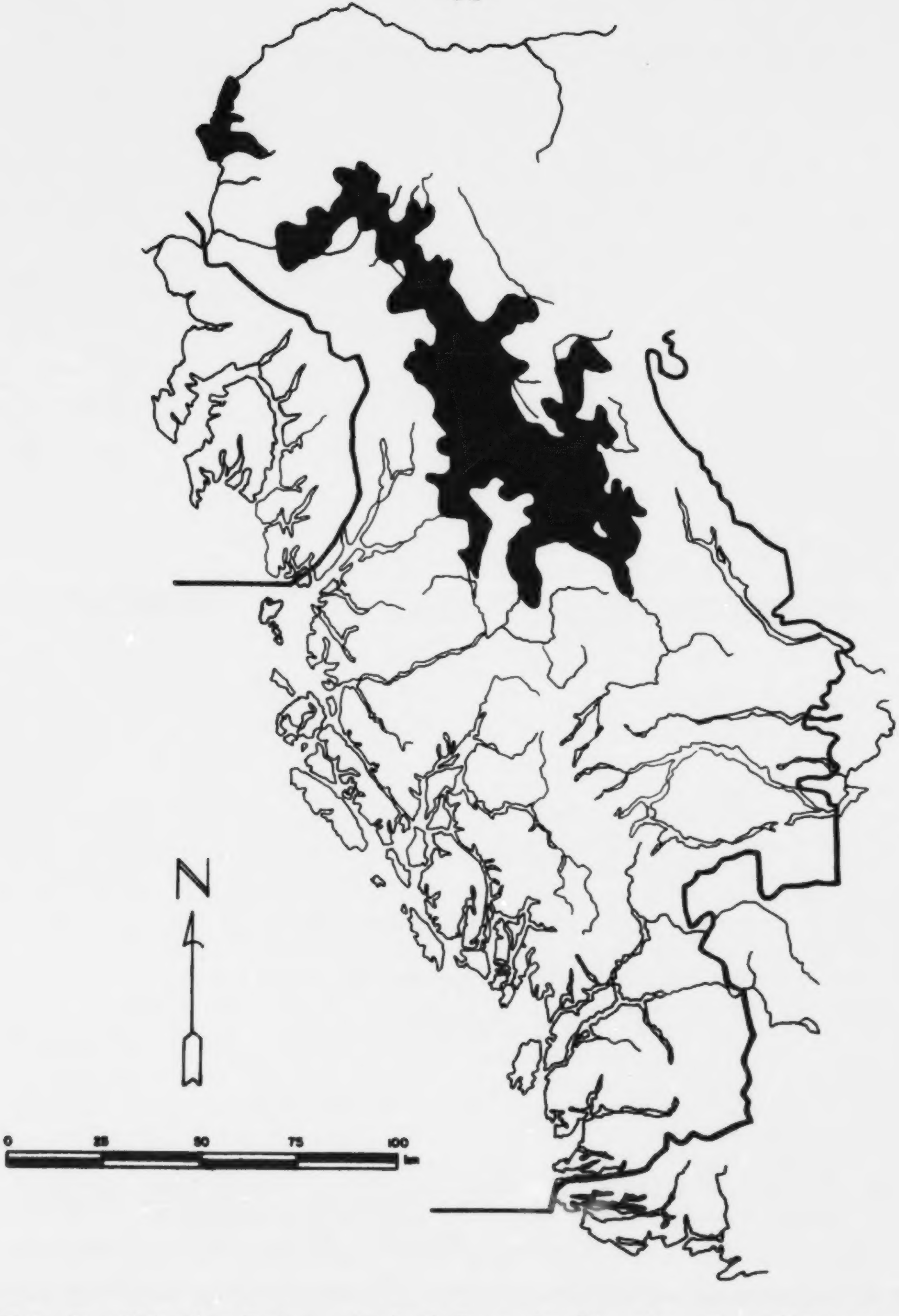
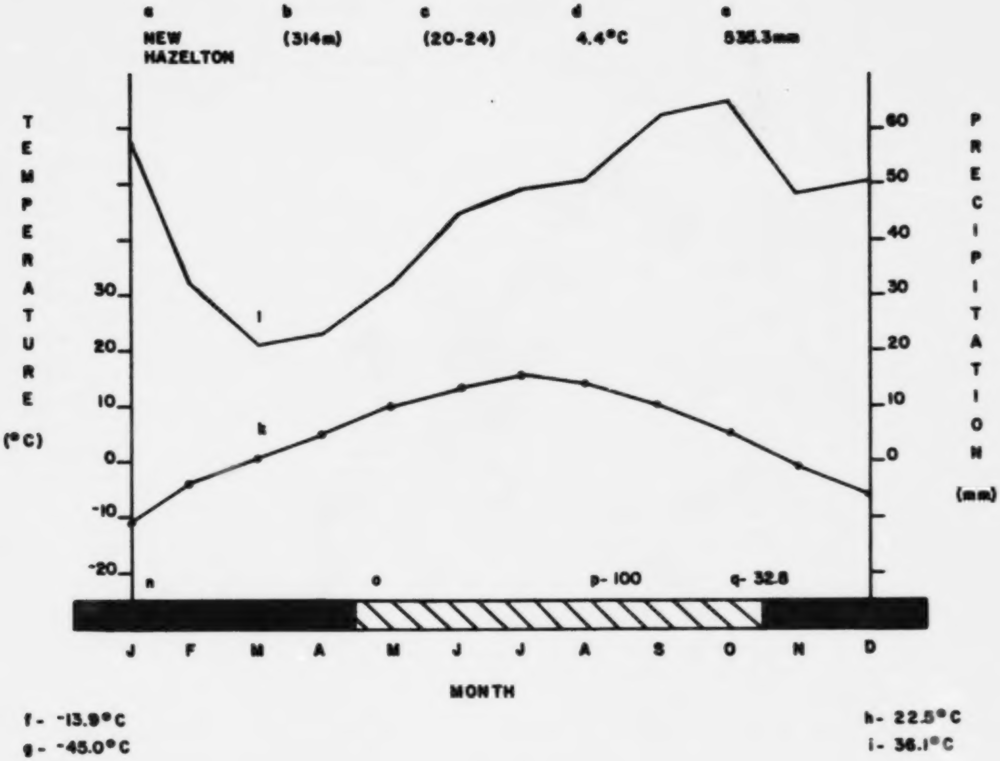

N
0
25
50
75
100
km

FIGURE 5. The Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg), in the Prince Rupert Forest Region.



a Station.
b Height above sea level (metres).
c Duration (years) of observations.
d Mean annual temperature.
e Mean annual precipitation.
f Mean daily minimum temperature of the coldest month.
g Lowest temperature recorded.
h Mean daily maximum temperature of the warmest month.
i Highest temperature recorded.
k Curve (dotted) of mean monthly temperature.
l Curve of mean monthly precipitation.
n Months with mean daily minimum temperature less than 0°C (black).
o Months with absolute temperature less than 0°C (frosts occur; black plus cross-hatching).
p Mean duration (days) of frost free period.
q Index of continentality = $\left[1.7 \left(\frac{\text{mean temp. July - mean temp. January}}{\text{sine degrees latitude}}\right) - 20.4\right]$

FIGURE 6. Representative climatic diagram for the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg).

and moisture gradually. This phenomenon results in the wide band of transitional climate that characterizes the ICHg.

Summarized briefly, the climate of the ICHg is warm and moist in summer, cool and wet in fall, and cold in winter. Average annual precipitation ranges from 500 to 1200 mm. Snowfall varies from moderately light to very heavy depending on location, and snowpacks last from 4 to 7 months. The ground is generally frozen throughout the winter and breakup occurs between early March and late May.

There is considerable climatic variation within the ICHg. Most of this variation can be attributed to four factors: longitude, latitude, elevation, and local topography. A strong climatic gradient exists from west to east across the ICHg. Western sections have a predominantly coastal-transitional climate, while eastern sections show dominantly continental or sub-boreal climatic influences. Precipitation, number of frost-free days, and winter temperatures all decrease significantly from west to east, while summer-time temperatures increase.

The ICHg has a latitudinal range extending from $54^{0}40'$ N on the Skeena River to 57°30' N on the Stikine River. Within this range there is considerable variation in temperature, precipitation, and length of growing season.

Elevation profoundly influences local climate. In general, high elevation mountain slopes are cooler, more humid, and receive more snow than low elevation valley bottoms. However, because cold air drains downslope, creating temperature inversions, the greatest temperature extremes and heaviest frosts are often experienced on the valley floor, while mid-mountain slopes have a more equable climate.

Local topographic features play a very important role in determining local climate. For example, rain-shadow areas that receive unusually low amounts of precipitation are often found on the leeward side of mountain barriers such as at Hazelton and Kitwanga. Sheltered middle elevation valleys like Boulder Creek in the Rocher de Boulé Range can be unusually wet and mild. Large lakes also can have a moderating influence on climate along the lakeshore.

5.3 Vegetation (Runka 1972; Haeussler 1980)

The transitional nature of the ICHg climate is reflected in the vegetation of the subzone, which combines elements of both coastal and interior flora. Climax forests are dominated by western hemlock, which occurs together with subalpine fir, hybrid spruce, and western redcedar.

Fire has had a major influence on the development of many plant communities in the subzone. Seral (nonclimax) stands composed of lodgepole pine, trembling aspen, paper birch, spruce, and subalpine fir dominate lower elevations in many parts of the ICHg. Even older stands, approaching climax, usually contain remnant individuals of the seral community. Except in sheltered locations such as middle elevation valleys and some north-facing slopes, it is difficult to find a climax stand in the ICHg that has not been disturbed by fire within the past few centuries.

Specific vegetation features that characterize the ICHg and can be used to distinguish it from neighbouring biogeoclimatic zones and subzones are listed in Table 3.

5.4 Geology (Holland 1976; Hutchison _et_ _al_. 1979; Souther _et_ _al_. 1979; Tipper _et_ _al_. 1979).

There are three major physiographic regions within the ICHg subzone in which geology and surficial materials can be defined. These are the Nass Basin, Hazelton Mountains, and Skeena Mountains. All of these regions lie east of the Coast Mountains and north of the Nechako Plateau. However, part of the ICHg5 (the northwestern-most variant) occurs in the Boundary Ranges of the Coast Mountains.

Over most of the ICHg, relatively fine-grained volcanic and sedimentary rocks dominate the geology. Such rocks are readily fractured through chemical and physical weathering when compared to the massive plutonic bedrock types of the Coast Mountains that underlie much of the CWHf subzone.

The Nass Basin occupies much of the central part of the ICHg subzone, particularly the ICHg1 and ICHg4 variants. The geology of the Nass Basin includes mainly thick deposits of sedimentary and volcanic rocks. Shale,

TABLE 3.

Synopsis of vegetation characteristics of the ICHg and adjacent biogeoclimatic zones and subzones

Key: **** widespread and dominant
*** widespread
** common
* uncommon
+ rare
- absent

VEGETATION CHARACTERISTICS	BIOGEOCLIMATIC ZONES AND SUBZONES			
	ICHg Interior Cedar - Hemlock Zone, Northwestern transitional subzone	CWHf Coastal Western Hemlock Zone, Northern drier maritime subzone (west of ICHg)	SBS Sub-Boreal Spruce Zone (east of ICHg)	ESSF Engelmann Spruce - Subalpine Fir Zone (high elevations above ICHg)
Climax tree species				
western hemlock (Tsuga heterophylla)	****	****	-	*
western redcedar (Thuja plicata)	***(southern sections)	***	-	-
amabilis fir (Abies amabilis)	*(higher elevations)	***(*)	-	-
subalpine fir (Abies lasiocarpa)	***	+	****(higher elevations, SbSe primarily)	****
mountain hemlock (Tsuga mertensiana)	+	+	-	**
Spruce hybridization	Interior and Sitka spruce characteristics (Picea glauca x sitchensis? x engelmannii)	dominantly Sitka characteristics (Picea sitchensis, P. sitchensis x glauca)	Interior spruce (Picea glauca x engelmannii)	Variable, dominantly Interior spruce (Picea glauca x engelmannii)
Seral tree species				
red alder (Alnus rubra)	-	**	-	-
lodgepole pine (Pinus contorta)	***	**(mainly low elevations)	***(*)	**
trembling aspen (Populus tremuloides)	***(especially southern sections)	* (mainly low elevations)	***	+
paper birch (Betula papyrifera)	***(especially southern sections)	* (mainly low elevations)	**	-
black cottonwood (Populus balsamifera ssp. trichocarpa)	**	**(mainly low elevations)	**	+
Other tree species				
black spruce (Picea mariana)	*(southern sections only)	-	**	-
Rocky Mountain juniper (Juniperus scopulorum)	+(southern sections only)	-	*	-

TABLE 3. (cont'd)

Key:
**** widespread and dominant
*** widespread
** common
* uncommon
+ rare
- absent

VEGETATION CHARACTERISTICS	BIOGEOCLIMATIC ZONES AND SUBZONES ICHg Interior Cedar - Hemlock Zone, Northwestern transitional subzone	CWHf Coastal Western Hemlock Zone, Northern drier maritime subzone (west of ICHg)	SBS Sub-Boreal Spruce Zone (east of ICHg)	ESSF Engelmann Spruce - Subalpine Fir Zone (nigh elevations above ICHg)
Climax shrub and herb species				
salmonberry (Rubus spectabilis)	*(northern and western sections only)	***	-	+
skunk cabbage (Lysichiton americanum)	*(western sections)	***	-	-
red huckleberry (Vaccinium parvifolium)	+	***	-	-
Alaskan blueberry (V. alaskaense)	*(*)(northern and western sections)	****	-	*
oval-leaved blueberry (V. ovalifolium)	**(*)	****	*	**(*)
black huckleberry (V. membranaceum)	***	**	****	****
Sitka valerian (Valeriana sitchensis)	+	+	+	***
arrowleaved groundsel (Senecio triangularis)	+	+	+	***
Indian hellebore (Veratrum viride)	+	+	+	***
mountain sage (Artemisia arctica)	-	-	-	***
pink mountain-heather (Phyllodoce empetriformis)	-	-	-	***
white mountain-heather (Cassiope mertensiana)	-	-	-	***
Seral shrub and herb species				
hazelnut (Corylus cornuta)	***(southern sections)	-	-	-
Nootka rose (Rosa nutkana)	**	***	-	-
goat's-beard (Aruncus dioicus)	*(*)	***	+	-
bracken (Pteridium aquilinum)	**	***	+	+
prickly rose (Rosa acicularis)	***(especially in southern sections)	*	***	*(+)
soopolallie (Shepherdia canadensis)	***(" " ")	*	***	*(+)
purple peavine (Lathyrus nevadensis)	***(" " ")	*	***	-
trailing raspberry (Rubus pubescens)	***(" " ")	*	***	*(+)
dwarf blueberry (Vaccinium caespitosum)	***(" " ")	*	***	*(+)
ricegrasses (Oryzopsis asperifolia, O. pungens)	***(" " ")	*	***	-
Mosses and liverworts				
Rhytidiadelphus loreus	*	****	-	+
Plagiochila porelloides	*(*)	***	-	+
Scapania bolanderi	*	***	-	+
Hypnum circinale	*	***	-	+
Rhytidiadelphus triquetrus	***(*)	**	**(*)	+
Ptilium crista-castrensis	***	*	****	**
Barbilophozia spp.	**	*	**	***(*)
Hylocomium splendens	****	****	***(*)	*(*)
Rhytidiopsis robusta	**(*)	***	+	**(*)

argillite, siltstone, greywacke, and mafic volcanic rocks are common throughout sections of the basin. Recent lava flows have occurred near Aiyansh. Ropy lava surfaces, flow breccia, and collapse features provide evidence of this flow which originated from the head of the Tseax River.

The Skeena Mountains, which form much of the eastern sections of the ICHg, have a complex bedrock geology consisting of extensively folded sedimentary and metasedimentary rocks. Rocks found within these ranges include fine to medium grained argillite, shale, and dark greywacke with some minor inclusions of granites. Argillite formations are relatively easily erodable and contain more bedrock-folding features than the more resistant, peak-forming greywacke deposits (Holland 1976).

The Nass, Kispiox, and Bulkley Ranges occur within the Hazelton Mountains physiographic region. The Hazelton Mountains lie east of the coastal granitic intrusions and are underlain largely by sedimentary and volcanic rocks that may contain isolated stocks and small batholiths of granitic rock. The Bulkley and Kispiox ranges have regularly occurring central cores of granite that may weather to produce coarser textured surficial deposits. Rock types dominating the Hazelton Mountains include those of the Hazelton Group; mainly andesitic to rhyolitic breccias, sandstone, shale, and conglomerate.

5.5 Surficial Materials (Runka 1972; Ryder 1978).

As in most areas of British Columbia, the surficial materials that have formed soils in the ICHg were deposited during and since the Fraser glaciation, the most recent glaciation of the province. There are five types of surficial materials found within the study area: morainal (glacial till), glaciofluvial, fluvial, colluvial, and organic materials.

Where surficial materials are derived largely from bedrock (i.e., glacial till, colluvium), the minerological composition and texture of the soil is closely related to the type of parent bedrock and its susceptibility to weathering. In deposits of unconsolidated sediments (glaciofluvial, fluvial), soil texture is determined primarily by the extent of water action upon deposition, and the weathering processes that follow. See the glossary for detailed definitions of surficial materials and landforms.

5.5.1 Glacial till

Glacial till refers to a heterogeneous mixture of sand, silt, and clay that has been deposited directly by glaciers. Such morainal deposits are the dominant soil parent materials of the Nass Basin, where numerous lake basins and drumlin-like landforms remain as evidence of glacial activity. Morainal blankets (greater than 1 m thick) and veneers (less than 1 m thick) also make up a major portion of surficial materials on level to moderately sloping surfaces that lie between valley floors and the bedrock and colluvial slopes of the higher elevations of the Hazelton and Skeena mountains. Soils derived from morainal deposits are mainly of fine to medium texture, which is largely a function of the fine-grained volcanic and sedimentary bedrock that prevails in the ICHg. Surficial materials arising from morainal deposits are usually moderately well to well-drained.

5.5.2 Glacial outwash (glaciofluvial)

Glaciofluvial deposits are loose, often well-drained materials (sands, gravels) that were deposited by meltwater either in contact with glacier ice or beyond the ice margin as outwash. Outwash plains and terraces are commonly found in the ICHg subzone on lower slopes adjacent to rivers.

5.5.3 Fluvial

Fluvial deposits include both recent (active) and older (inactive) sediments, and occur in valley floors wherever rivers and streams occur. Major fluvial deposits of the ICHg occur along the Nass, Skeena, Bulkley, Kispiox, Cranberry, Kitwanga, Bell-Irving, Iskut, and Stikine rivers. Less extensive fluvial deposits can be found adjacent to numerous small streams. Coarse sands are often deposited in steep mountainous areas, whereas finer textured sands and silts are more common on floodplains that have been laid down by low gradient rivers (e.g., Skeena). Fluvial terraces, floodplains, and fans are fluvial landforms that can be found. Drainage within fluvial materials is generally good, but is strongly dependent on the depth of water table.

5.5.4 Colluvial

Colluvial materials represent deposits of loose, angular fragments that occur in any range of particle sizes from clay to large blocks of fractured bedrock. Colluvial deposits are the products of mass wastage and have reached their present position through gravity-induced movement. Rockslides and slumping are two common examples of colluvial activity within the ICHg. Colluvial deposition increases as the slope increases, particularly within numerous areas of the Skeena and Hazelton mountains. Colluviated till is also common in these mountains. Relatively weak bedrock structure (porous, folded), steep slopes, and extensive freezing and thawing action within much of the mountainous area of the ICHg promote failures and gravity-induced movement. Colluvial materials are usually well-drained, as a consequence of poor sorting of materials upon deposition and the high coarse fragment (greater than 2 mm diameter) content.

5.5.5 Organic

Organic deposits commonly develop on very gentle slopes or in isolated depressions throughout the ICHg. Bogs and fens represent two types of poorly to very poorly drained organic deposits, and are particularly common in the ICHg3. Organic layers develop on poorly drained sites where the rate of accumulation of plant matter exceeds the rate of decay.

On some of the steeper slopes of the Hazelton and Skeena mountains, thin organic layers (Folisols) may develop over bedrock. These deposits are generally well-drained in comparison to the peat of bogs, fens, and swamps.

5.6 Soils (Runka 1972)

The soils of the ICHg subzone are composed mainly of mineral materials, most of which were deposited during glaciation. Luvisols and Podzols occur often on sloping valley sides where glacial till has been deposited. Brunisols and Podzols are common soils found on the steepest mountain slopes, where colluvial deposits occur. Podzols and Regosols can be found on alluvial sites in the valley bottoms. Weathering of predominantly volcanic and sedimentary bedrock within the ICHg results in the formation of loamy or finer textured soils. Rainfall generally increases with elevation, thus leaching increases and affects profile development. The soil environment is strongly affected by seasonal temperature differences among the variants.

6 GENERAL CHARACTERISTICS OF THE VARIANTS

Within the ICHg there is considerable climatic variation. This variation corresponds primarily to differences in longtitude, latitude, elevation, and surrounding topography within the subzone. The climatic variation is strongly reflected in vegetation characteristics such as the distribution of tree species within the subzone, and patterns of plant communities in the landscape. In order to recognize this variation, we have subdivided the ICHg subzone into five distinct biogeoclimatic variants:

ICHg1: Upper Nass Basin variant
ICHg2: Lower Nass Basin variant
ICHg3: Hazelton variant
ICHg4: Meziadin-Bell-Irving variant
ICHg5: Iskut-Stikine variant.

Figure 7 is a map of the ICHg showing the distribution of its variants. A description of each of the biogeoclimatic variants follows. General characteristics of the variants are summarized in Table 4. In Figure 8, profile diagrams show the elevational sequence or stratification of the variants on typical mountain slopes in the Nass and Skeena drainages.

6.1 ICHg1 - Upper Nass Basin Variant

6.1.1 Geographic description

The ICHg1 or Upper Nass Basin variant covers the undulating terrain that extends roughly north and east of Cranberry junction. Major drainages in the east include the Skeena River above Cutoff Mountain, the lower reaches of Shedin Creek and Babine River, and the Kispiox River north of its junction with the Sweetin River. Major portions of the Nass River drainages are included: the upper Nass below Damdochax Creek to the mouth of the Bell-Irving River, and again from Meziadin River to the Cranberry River. A tongue of ICHg1 extends southwest on the north side of the Nass, including the lower Kinskuch River. In the southeastern portion of the subzone, a mid-elevational belt of ICHg1 extends above the ICHg2 from approximately 750 to 1100 m elevation.

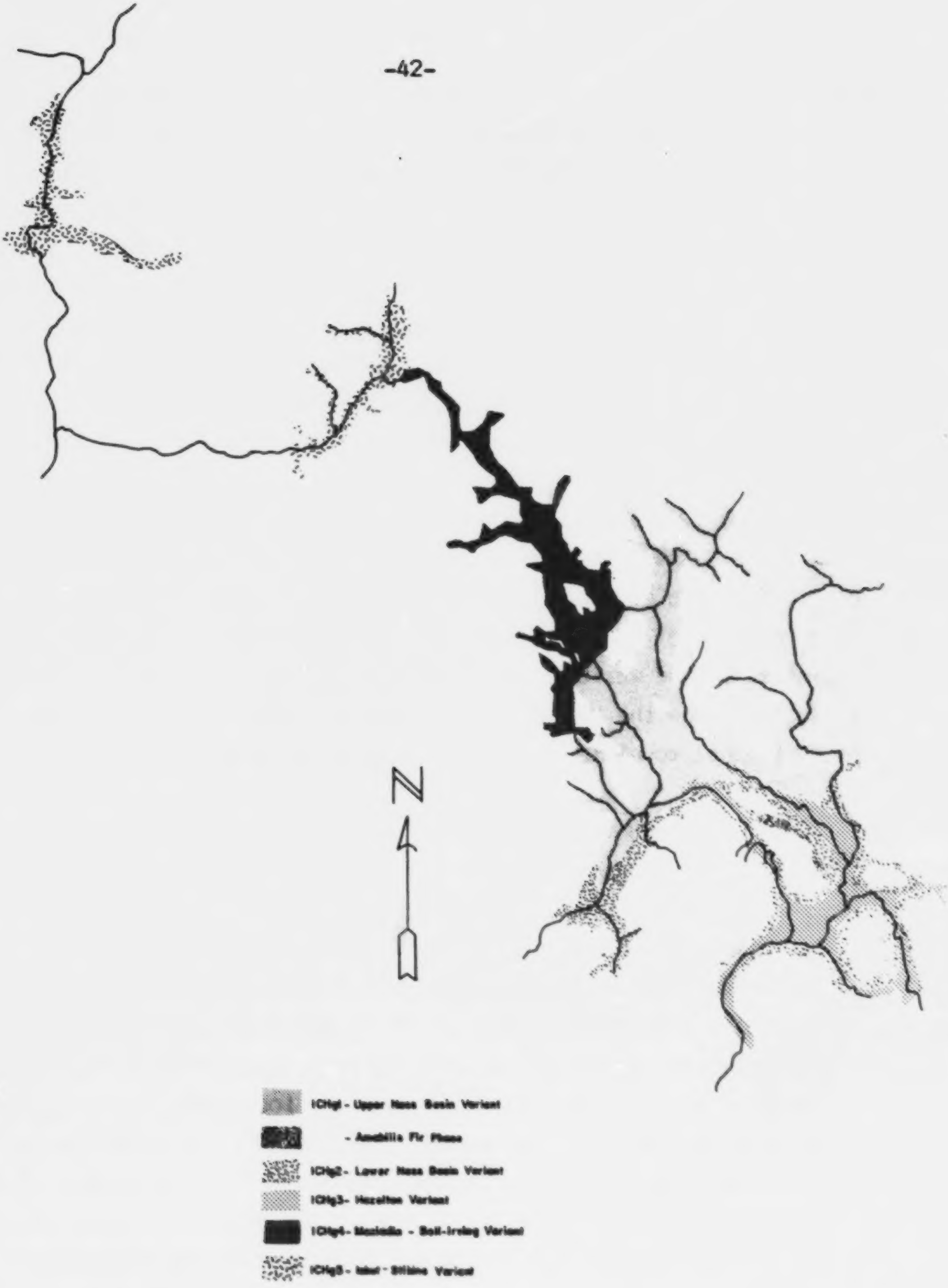

ICHg1 - Upper Nass Basin Variant
- Amabilis Fir Phase
ICHg2 - Lower Nass Basin Variant
ICHg3 - Hazelton Variant
ICHg4 - Meziadin - Bell-Irving Variant
ICHg5 - Iskut - Stikine Variant

FIGURE 7. Biogeoclimatic variants of the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg).

TABLE 4.

Synopsis of the biogeoclimatic variants of the ICHg

CHARACTERISTICS	ICHg1 upper Nass Basin (subalpine fir) variant	ICHg2 lower Nass Basin (cedar) variant	ICHg3 Hazelton (aspen) variant	ICHg4 Meziadin - Bell-Irving (snowy) variant	ICHg5 Iskut - Stikine variant
Geographic distribution	Nass River: Cranberry Junction - Meziadin R.; Bell-Irving R. - Damdochax Ck. upper Skeena and Kispiox rivers above ICHg2 in southeast.	Nass River Valley: Cranberry Junction - Tseax R.; mid-elevation belt above contiguous ICHg3.	central valley floors; Skeena R.: Sedeish Ck.- Legate Ck.; lower Bulkley, Suskwa, Kispiox, Kitwanga, and Cranberry rivers.	Meziadin Lk. north to Ningunsaw Pass; White R. valley.	middle Iskut and Stikine drainages east of the crest of the Coast Mountains.
Elevational range (approximate)	(150) 300 - 950 (1100) in Nass Basin; (600) 750 - 950 (1100) in southeast.	100 - 600 Nass Valley; 450 (600) - 750 (900) Skeena valley.	150 - 450 (600).	240 - 1000.	150 - 900
Climate	cool, moist; longest and most severe winters, moderately heavy moist or dry snow; minor summer drought.	mild, moist with moist snow in Nass valley; harsher in southeastern Skeena-Bulkley valleys. Intermediate between g1 and g3 variants; moderate snowfall.	winters relatively dry, cold with light, dry snowpack; short frost-free period, cold air ponding. Summers warm, relatively dry, hottest temperatures in subzone. Significant summer drought.	very heavy snowpack (3-6m). Winters generally wetter, less severe than ICHg1. Summers cool, moist. Little or no summer drought. Shortest growing season due to high latitudes and persistent snowpack.	cool, moist; winters wet with moderately heavy, moist snow. Summers cool, moist; little or no summer drought.
Vegetation:					
major tree species	Hw*, Bl, (Sx); (Ba in Ba phase) Cw absent.	Hw, Cw, (Bl, Sx, Pl).	Sx, Pl, Bl, At, Ep, Hw, Cw.	Bl, Hw, Sx; Cw absent.	Hw, Bl, Sx, Act; Cw absent.
seral stands	only extensive in southern sections; dominantly Pl, Bl, Sx.	frequent in Nass Valley, less common elsewhere; Pl, Sx, Bl, At, Ep.	widespread and dominant. Extensive stands of At - Ep - hazelnut and other shrubs. Also Pl, Sx, Bl, and Act.	uncommon; mostly Bl; Pl rare; At on a few south-facing slopes.	uncommon except on floodplains; Pl, Act, Ep, At.

TABLE 4. (cont'd)

CHARACTERISTICS	ICHg1 upper Nass Basin (subalpine fir) variant	ICHg2 lower Nass Basin (cedar) variant	ICHg3 Hazelton (aspen) variant	ICHg4 Meziadin - Bell-Irving (snowy) variant	ICHg5 Iskut - Stikine variant
Vegetation (cont'd):					
zonal plant (sub)association	Hw - (Bl) - (Vaccinium ovalifolium, V. alaskaense, V. membranaceum) - Hylocomium splendens - Pleurozium schreberi	Hw - (Cw) -(Paxistima myrsinites - Chimaphila umbellata - Clintonia uniflora) - Hylocomium splendens - Ptilium crista-castrensis - Pleurozium schreberi - Rhytidiadelphus triquetrus	Hw - (Cw, Bl, Sx) - Hylocomium splendens - Rhytidiadelphus triquetrus - Pleurozium schreberi - Ptilium crista-castrensis	Hw - Bl - (Sx) - Vaccinium alaskaense - V. ovalifolium - V. membranaceum - Cornus canadensis - Hylocomium splendens - Pleurozium schreberi - Ptilium crista-castrensis	Hw - Vaccinium alaskaense - V. ovalifolium - V. membranaceum - Hylocomium splendens - Pleurozium schreberi
miscellaneous notes	(Ba phase: Hw - Ba - Vaccinium ovalifolium - V. membranaceum - Rubus pedatus - Hylocomium splendens)	(extensive moss carpets may cover even moister (subhygric) sites, especially in southeastern sections)	(climax Hw stands scarce except on north-facing slopes. Most stands contain seral remnants of Pl, Rubus parviflorus, Rosa acicularis, Amelanchier alnifolia, etc.)	(extensive areas of subhygric to hygric Bl - Sx - Oplopanax horridus - Gymnocarpium dryopteris - Mnium spp.)	(extensive Sx - Bl - (Hw) - Oplopanax horridus - Gymnocarpium dryopteris communities; abundant Act floodplain forests).
understory vegetation features	Vaccinium alaskaense present; V. ovalifolium and Rubus pedatus abundant.	Vaccinium alaskaense, Rubus pedatus lacking; Vaccinium ovalifolium scattered on zonal sites.	Vaccinium alaskaense, V. ovalifolium, Rubus pedatus lacking on zonal sites.	Vaccinium alaskaense, V. ovalifolium, Rubus pedatus abundant.	Vaccinium alaskaense V. ovalifolium, Rubus pedatus abundant.
Landforms:					
lower elevations: (valley floors)	fluvial terraces and morainal blankets.	fluvial terraces and glaciofluvial outwash; minor morainal blankets.	extensive fluvial terraces and active floodplains; organic deposits.	fluvial terraces and morainal blankets.	extensive fluvial terraces and active floodplains; morainal blankets.
middle to upper elevations:	morainal and/or colluvial veneers and blankets (Ba phase: colluvial veneers and blankets).	morainal and/or colluvial veneers and blankets.	morainal blankets and veneers.	morainal veneers and/or blankets; colluvial veneers on steepest slopes.	colluvial and morainal veneers and/or blankets.
Zonal Soils:	Orthic Humo-Ferric Podzols (Ba phase: Orthic Ferro-Humic Podzols).	Brunisolic Gray Luvisols; Podzolic Gray Luvisols; Orthic Humo-Ferric Podzols (minor).	Orthic Humo-Ferric Podzols; Podzolic Gray Luvisols.	Orthic Humo-Ferric Podzols.	Orthic Humo-Ferric Podzols.

*Tree species symbols as in Appendix 2.

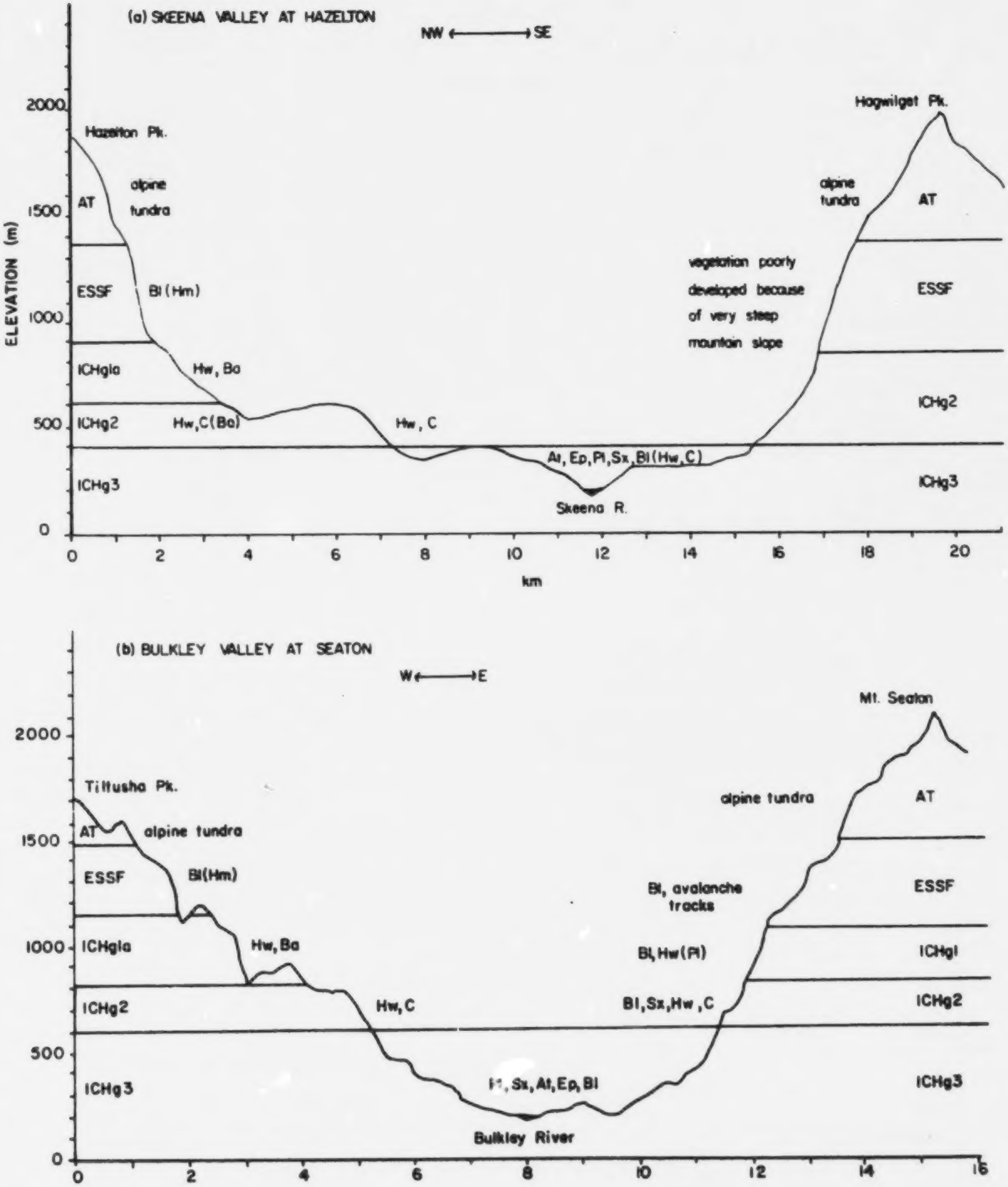


FIGURE 8 a and b. Representative valley profiles showing distribution of biogeoclimatic units in the study area.

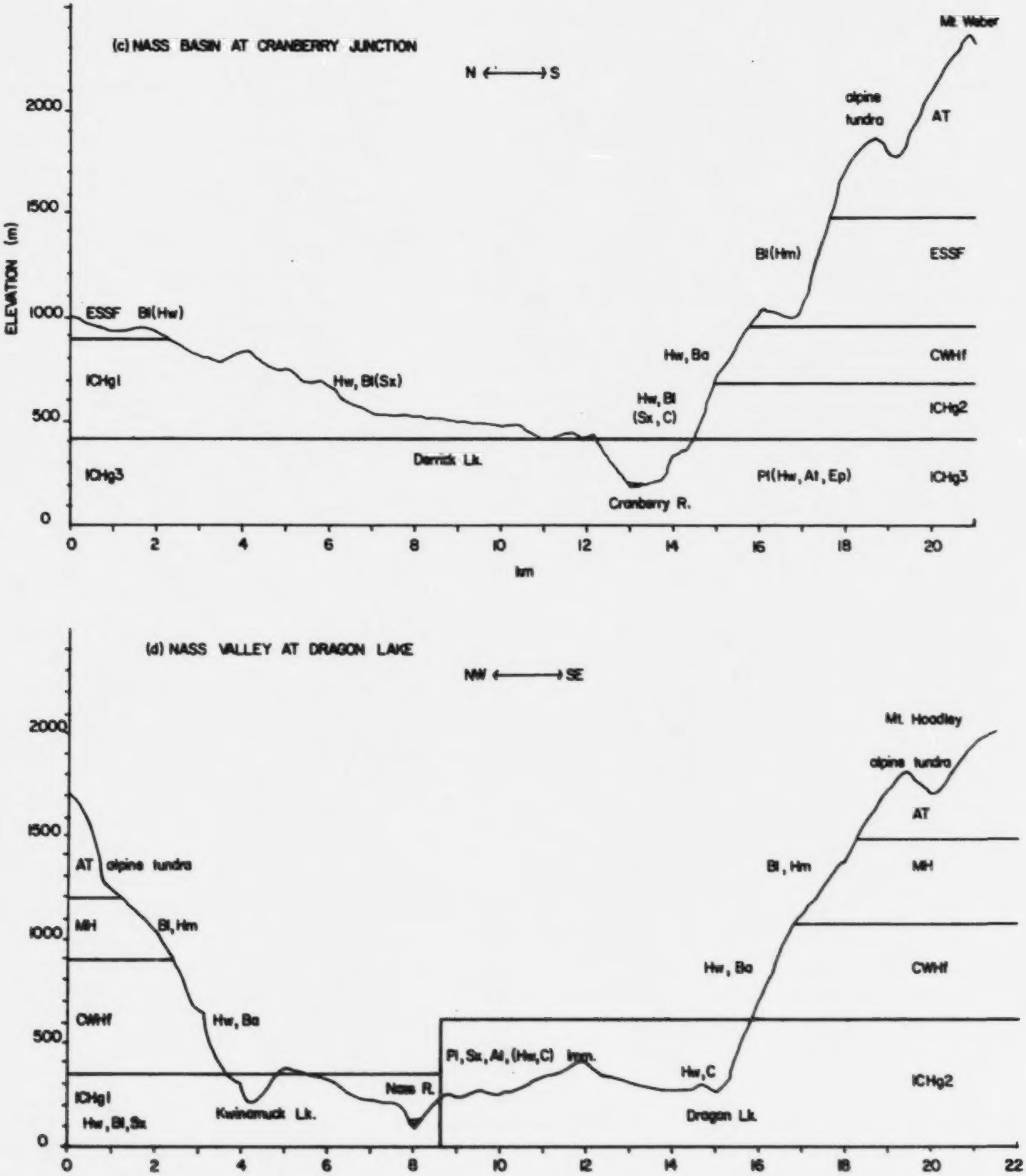


FIGURE 8 c and d. Representative valley profiles showing distribution of biogeoclimatic units in the study area.

6.1.2 Climate

Very little climatic information is available for the ICHg1 because the area is virtually unsettled. We do know that precipitation tends to be higher than in the more southerly ICHg2 ang g3 variants and that snowpacks are both deeper and of longer duration. In the ICHg1, winters are cold with mainly dry snow and summers are cool and moist. The growing season is considerably shorter than in the g2, g3, and perhaps the g5 variants.

6.1.3 Vegetation

Because climatic data are so limited, we rely mainly on vegetation characteristics to delineate the biogeoclimatic variants. The primary criterion used to distinguish the ICHg1 from adjacent g2 and g3 variants is the absence of western redcedar. Presumably the ICHg1 is too cold (especially in winter) and has too short a growing season for this species. The upper Nass Basin variant is also referred to as the subalpine fir variant because subalpine fir is the main associate of western hemlock in upland forest, and often dominates stands on low-lying, wetter sites. Amabilis fir is scattered in the southwestern portions of the variant, but is under severe climatic stress on most sites and grows very poorly.

Seral (non-climax) stands are not extensive except in low elevation southern portions of the variant, adjacent to the ICHg3. Lodgepole pine is the dominant seral species but trembling aspen and paper birch are also common, especially on south-facing slopes.

6.1.4 Soils[7]

Hummocky glacial till deposits of the Nass Basin cover most of the ICHg1 landscape. Because sedimentary bedrock dominates a large proportion of this variant, a wide variety of mineral textures result from glacial activity and bedrock weathering. Predominant soils developing on morainal blankets are Orthic Humo-Ferric Podzols (containing reddish brown to yellowish red Bf horizons) with coarse loamy soil textures. Leached, whitish, surface mineral horizons are generally thin or lacking in these Podzols. Orthic Dystric Brunisols (acidic, with a brown Bm horizon) and Podzols are common on the dry, steep, colluvial slopes. Where bedrock knobs occur, shallow soils such as Lithic Folisols (thin organic layers over bedrock) or thin Podzols are found. These soils are rapidly drained and their nutrient status strongly depends on the type of parent bedrock.

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[7] The soil descriptions and comparisons within the variants of the ICHg are based only on soil types with a moderate (mesic) supply of nutrients and moisture.

The major humus forms found in the ICHgl are acidic Orthihemimors, in which fungal decomposition occurs. Organic materials formed on zonal soils range in thickness from 5-14 cm, with depth generally increasing with available moisture.

6.1.5 Amabilis fir phase (ICHgla)

On northeastern slopes and in small sheltered valleys of the Rocher de Boule and Kispiox Ranges, and between approximately 750 and 1100 m elevation, there exist enclaves of a seemingly coastal forest of western hemlock and amabilis fir. We describe these forests as the Amabilis fir phase of the ICHgl variant (ICHgla). The trees in the Amabilis fir phase often reach coastal dimensions (amabilis fir and spruce 45-50 m in height are not uncommon), and typically coastal understory species such as salmonberry (*Rubus spectabilis*) and *Rhytidiadelphus loreus* are present. Soils are frequently Ferro-Humic Podzols and humus layers are unusually thick. In general, the ICHgla bears a very strong resemblance to higher elevation forests of the Coastal Western Hemlock biogeoclimatic zone.

The ICHgla consists of old-growth stands that show no signs of past fire for many generations. The phase occurs in areas of unusually humid local climate. It seems probable that during the summer cloudbanks often land directly over or in the ICHgla elevational band, producing above-average precipitation and humidity and cool temperatures. During the winter, the ICHg1a is above the ceiling of the cold inversion layer that often develops in the valley bottom. The vigorous growth of amabilis fir may also reflect heavy snowfalls that begin early in fall, thus insulating the soil from winter frost.

6.2 ICHg2 - Lower Nass Basin Variant

6.2.1 Geographic description

The ICHg2, Lower Nass Basin or cedar variant is found in the Nass River valley from Cranberry junction to the Tseax River valley, near Aiyansh. In the Nass drainage it ranges from the valley floor to an elevation of approximately 600 m. In the Skeena drainage, the ICHg2 occurs as a mid-elevation belt above the Hazelton (ICHg3) variant. The ICHg2 belt begins anywhere between 450 and 600 m in elevation and extends upslope to between 750 and 900 m. A discontinuous belt of ICHg1 is found above the g2 in eastern sections of the subzone.

6.2.2 Climate

The western sections of the variant are moist and cool. They receive moderate amounts of moist snow in the winter and total annual precipitation can exceed 1000 mm. In eastern sections, continental climatic influences are stronger. Summer temperatures are probably warmer than in the Nass valley but winters are colder. Snowpacks are moderately light and annual precipitation probably does not exceed 700-800 mm. In general, the ICHg2 climate is intermediate between that of the ICHg1 and g3 variants.

6.2.3 Vegetation

Climax forests in the ICHg2 are dominated by western hemlock and western redcedar together with lesser amounts of subalpine fir and spruce. Amabilis fir is generally absent from the variant. Seral stands are quite common at lower elevations in the ICHg2, particularly in the Nass valley. However, for the most part, they do not seem as firmly established as the extensive seral stands in the ICHg3; a successional trend towards hemlock and cedar is generally apparent. Most mature hemlock - cedar stands contain a few overmature individuals of lodgepole pine, paper birch, or trembling aspen, indicating a relatively recent fire origin.

Understory layers of hemlock-dominated stands are characterized by a thick carpet of feather moss. In some colder, eastern sections of the variant this acidic moss and humus layer seems to take over even the wetter habitats, virtually excluding other understory plants. In contrast, in stands with a heavy component of cedar or some deciduous species the growth of feather mosses is held back and herbs are quite abundant.

6.2.4 Soils

There is an increasing trend in the ICHg2 toward the development of fine textured Luvisols, especially in the Kispiox and Hazelton areas. B horizons of massive to blocky structure and clayey texture are characteristic of Brunisolic Gray Luvisols. A loamy, brown-coloured surface mineral horizon (Bm) commonly overlies the clay-rich Bt horizon, and supports abundant rooting. "Clay skins" (shiny coatings on coarse fragments, ped surfaces, and/or within pores) provide evidence of clay movement in these fine textured Luvisols. Compacted subsurface layers may restrict rooting in the fine textured soils. Coarser textured Podzols that do not restrict root penetration are very common in the Nass Valley. Relatively high volumes of coarse fragments occur in soils located on steep colluvial slopes, and on morainal veneers of middle to upper elevations.

Forest-floor organic materials are similar in form and depth to the humus forms of the ICHg1.

6.3 ICHg3 - Hazelton Variant

6.3.1 Geographic description

The ICHg3, Hazelton variant is centred on the valley floor of the Skeena River between Tenas Hill and Legate Creek. Arms of the ICHg3 extend up major tributaries of the Skeena including the Bulkley River below Trout Creek, the Kispiox River below Sweetin River, and the Kitwanga, Kitseguecla, and Suskwa River valleys. From the valley bottoms, the ICHg3 extends upslope to between 450 and 600 m in elevation.

West of Cedarvale the ICHg3 borders at its upper elevations on the Northern drier maritime subzone of the Coastal Western Hemlock Zone (CWHf). To the east, it is bounded at upper elevations by the ICHg2.

6.3.2 Climate

The climate of the ICHg3 is fairly well-documented because climatic stations have been established at several valley bottom locations within the variant for many years. Of the five ICHg variants, the Hazelton variant clearly has the most favourable climate for settlement and agriculture.

Total annual precipitation ranges from over 725 mm annually west of Cedarvale to below 480 mm annually near Hazelton. Much of the variant seems to be within the rain-shadow of surrounding mountains. Summers are warmer and sunnier in the ICHg3 than anywhere else in the subzone, and significant periods of drought are quite common. During the winter, the ICHg3 is relatively dry and receives little snow (113 cm on average at New Hazelton). Temperatures are often very cold because cold air drains into the valley bottoms and sets up temperature inversions that may persist for several weeks. A very short frost-free period is also characteristic of the ICHg3 climate.

Because of its position in the bottoms of major river valleys, the ICHg3 is often affected by surges of warm, moist air from the Coast or of cold dry air from the Interior. It is therefore subject to greater climatic fluctuations than other variants of the ICHg.

6.3.3 Vegetation

The vegetation of the Hazelton variant reflects the influence of frequent natural fire and widespread human disturbance. The ICHg3 is also referred to as the aspen variant because of the extensive seral stands of trembling aspen and paper birch that have established themselves as a result of the fires and land clearing. These deciduous stands have dense shrub and herb layers and little or no moss on the forest floor. Hazelnut (Corylus cornuta) is very characteristic of the Hazelton variant; it is a dominant shrub within the variant and is rare or absent outside the ICHg3.

Lodgepole pine, spruce, and subalpine fir are the dominant coniferous tree species. In many areas of the ICHg3, stands bear a strong resemblance to those found in the Sub-Boreal Spruce Zone (SBS) because subalpine fir and spruce are the dominant species reproducing under the tree canopy.

Western hemlock and western redcedar are the true climatic climax tree species in the ICHg3 but their distribution is restricted. Small patches are scattered throughout the landscape and larger stands occur mainly on north-facing slopes and at the higher elevations, where disturbance has been less severe and climatic stress is less pronounced. Both hemlock and cedar seem to be stressed by conditions in the ICHg3; they are highly susceptible to decay and establish themselves slowly under stands of shade-intolerant tree species. Much of the cedar in the ICHg was removed from older stands during past selective logging.

There are few floristic criteria that can be used to distinguish climax stands of the ICHg3 from those of ICHg2 where the two variants occur one above the other on a mountain slope. Elevation and the relative abundance of successional stands are the two major criteria used to differentiate the variants in such areas.

6.3.4 Soils

The ICHg3 occupies primarily the valley floors, where coarse textured Podzols dominate, particularly on inactive glaciofluvial and fluvial landforms. On morainal deposits, weak Luvisols as well as Podzols may occur on lower slopes and in side valleys. Compacted subsurface clay horizons may restrict rooting in some fine textured soils. In the shallowest soils, the bedrock and surface organic materials may strongly influence the nutrient status of the site.

Humus forms are dominantly Mors (Orthihemimors) ranging from 5-12 cm in depth under mature climax forests. Fungal decomposition predominates, although the ICHg3 has a greater abundance of deciduous trees that usually provide a favourable environment (less acidic litter) for insect (zoogenous) decomposition. Zoogenous activity generally results in increased rates of humus decomposition and the production of organic-rich mineral layers (Ah).

6.4 ICHg4 - Meziadin - Bell-Irving Variant

We have completed only preliminary studies of the ICHg4, or Meziadin - Bell-Irving variant, and are therefore unable to characterize this variant in detail. We hope to complete the classification of ecosystem units soon so that they may be added to revisions of this publication. In the meantime, we suggest that you refer guardedly to the descriptions and guidelines presented for the ICHgl when working in the g4 variant. Keep in mind that the ICHg4 has a distinct and unique set of characteristics that must be taken into account in management decisions.

6.4.1 Geographic description

The Meziadin - Bell-Irving variant of the ICHg extends from the White River and Niska Lakes area north along the Bell-Irving River to Ningunsaw Pass. It does not appear to extend east of the junction of the Nass and Bell-Irving Rivers, nor into the main Nass Valley south of Meziadin lake. The ICHg4 ranges in elevation from 240 m at Meziadin Lake to approximately 900-1000 m on some mountain slopes.

6.4.2 Climate

We refer to the ICHg4 as the snowy variant because of the very large amounts of moist snow it receives. Normal maximum snowpacks are estimated at between 2.5 and 5 m in depth, well over twice as deep as at equivalent elevations in the ICHgl.

During most of the year, the ICHg4 is cool and moist. It is usually slightly cooler in summer and milder in winter than adjacent parts of the ICHgl. It is estimated that the ICHg4 receives between 800 and 2000 mm of precipitation annually, which is high relative to most other parts of the subzone. Much of this precipitation falls as snow, but effective summer moisture is high and soils rarely dry out because of the cool temperatures and the large amount of runoff available from melting snow. Because of its northerly latitude and short snow-free period (May-October), the ICHg4 has a short growing season relative to more southerly sections of the ICHg.

6.4.3 Vegetation

The effects of heavy snowloads are very apparent in patterns of vegetation found in the ICHg4. Western hemlock is the dominant tree species on mesic or zonal sites, but the occurrence of these well-drained upland sites is limited. A major portion of the landscape is occupied by poorly drained, low-lying sites or slopes receiving abundant seepage. Such sites are dominated by subalpine fir together with spruce, and contain very little hemlock. Subalpine fir grows exceptionally well in the ICHg4 and often reaches record size. It is obviously the tree species best adapted to growing conditions in the g4 variant. In association with the subalpine fir are understory layers dominated by devil's club (Oplopanax horridus) and oak fern (Gymnocarpium dryopteris) that seem to extend from valley bottom to ridge top.

Western redcedar is absent from the ICHg4, while amabilis fir is common only in the Niska Lakes area at the southern end of the variant. Mountain hemlock, a species well-adapted to heavy snow conditions, is found at unusually low elevations in the ICHg4.

Fire seems to have had little influence on the development of vegetation in this variant. There are stands of trembling aspen on a few south-facing slopes but, in general, seral stands are of minor occurrence and subalpine fir is the most frequent pioneer tree. Lodgepole pine is especially uncommon; it seems to be poorly adapted to the ICHg4 climate.

Avalanches are the major disturbance factor in the ICHg4. Broad swaths of Sitka alder (Alnus viridis ssp. sinuata) and other pioneer species extend from upper mountain slopes into the valley bottoms and are a prominent visual feature of the ICHg4.

6.4.4 Soils

Due to limited sampling within the ICHg4 variant, detailed knowledge of soil chemistry, surficial materials, and other soil features is lacking.

Organic layers are often compact-matted due to the heavy snow loads. Fungal decomposition is prominent, as signified by abundant white and yellow mycelia within decomposing layers. Acidic humus forms (Mors) and underlying Podzols are dominant.

Coarse textured Podzols with reddish brown mineral horizons (Bf) extend to depths greater than 30 cm. These horizons may be overlain by a leached, whitish coloured surface horizon (Ae), 3 to 6 cm in depth, which usually indicates a well-drained soil.

6.5 ICHg5 - Iskut - Stikine Variant

The ICHg5 (or Iskut - Stikine variant) is, like the ICHg4, little sampled and poorly known. The ICHg5 seems most similar to the ICHg1 and, until we do more work in this remote, northern variant, can be usefully studied and interpreted in the context of existing knowledge about the ICHg1.

6.5.1 Geographic description

The Iskut - Stikine variant of the ICHg occupies low to medium elevations (150 to 900 m) in the central part of the Iskut and Stikine River valleys, east of the crest of the Coast Mountains. In the Iskut drainage, the ICHg5 extends from the lower Ningunsaw River and Durham-Ball creeks downstream to Snippaker Creek. The variant occurs in the Stikine drainage from Dokdaon Creek to just below the Scud River.

6.5.2 Climate

The ICHg5 is the most northerly variant of the subzone, but because of generally lower elevation and fairly close communication with coastal areas, has a moist climate that is evidently milder than that of the ICHg3 and g4 and probably also the eastern sections of the g1. Snowpacks are moist and moderately heavy, but not nearly as heavy as in the Meziadin - Bell-Irving variant. Because of its proximity to boreal regions, the ICHg5 probably experiences more frequent or severe outbreaks of Continental Arctic air masses in winter than other ICH variants, except perhaps the ICHg3.

6.5.3 Ecological features

Western hemlock is the climatic climax species of the ICHg5 and forms extensive, old-growth, often "decadent" stands; western redcedar is absent. Subalpine fir and hybrid Sitka x white spruce sometimes occur in mature forest on zonal sites; both species are abundant on moist rich sites and in areas of cold air drainage or ponding. Black cottonwood, along with the hybrid spruce, forms floodplain forests. Lodgepole pine, aspen, and paper birch are scattered, forming seral forest in burned-over areas, especially in the vicinity of Bob Quinn Lake.

The Western hemlock - Vaccinium spp. - Hylocomium splendens - Pleurozium schreberi association represents climatic climax vegetation. Western hemlock dominates the zonal forests, and is sometimes joined by subalpine fir and hybrid spruce. Subalpine fir and spruce, however, do not persist to a great extent in old stands. They seem to die at an earlier age than hemlock, and also regenerate in climax stands primarily in openings or gaps. Typical shrubs include blueberries and huckleberries (Vaccinium alaskaense, V. ovalifolium, V. membranaceum), and false azalea (Menziesia ferruginea). Characteristic herbs are bunchberry (Cornus canadensis), one-sided wintergreen (Orthilia secunda), queen's cup (Clintonia uniflora), five-leaved bramble (Rubus pedatus), and prince's pine (Chimaphila umbellata). Hylocomium splendens, Pleurozium schreberi, and Ptilium crista-castrensis dominate the ground cover. Rhytidiadelphus triquetrus and Barbilophozia lycopodioides are common but usually not abundant. R. loreus is relatively uncommon.

Zonal ecosystems typically have moderately well-drained Humo-Ferric Podzols with Hemimor or Mormoder humus forms.

Drier forest ecosystems are uncommon in the ICHg5. They occur mostly on shallow soils over bedrock (e.g., in the vicinity of the Iskut Canyon) or on steep, rocky colluvial slopes. Mature stands on dry sites are usually a mixture of lodgepole pine, western hemlock, subalpine fir, and hybrid Sitka spruce, whereas earlier seral stands may be dominated by pine, aspen, and paper birch.

Moist rich Devil's club ecosystems are common and widespread. They usually occupy lower slopes or stable alluvial terraces. Hybrid Sitka spruce and subalpine fir of excellent growth dominate the canopy, while poorly growing western hemlock often forms a subcanopy or may be abundant as regeneration. Devil's club dominates the shrub layers. Oak fern, spiny wood fern (Dryopteris assimilis), twistedstalks (Streptopus spp.), three-leaved foamflower (Tiarella trifoliata), and five-leaved bramble are characteristic herbs. Brachythecium spp. and Mnium spp. dominate the patchy moss layer.

7 ECOSYSTEM UNITS OF THE ICHg

7.1 Introduction and Definitions

In this section, we outline the classification of ecosystem units in the ICHg. The ecosystem units are grouped into subsections according to the biogeoclimatic variant in which they are found. On the first page of each subsection is a list of the ecosystem units found in the variant. On subsequent pages, each ecosystem unit is described in detail so that it can be easily identified in the field.

The description for each ecosystem association consists of three pages: a general page, including a schematic representation of the association and line drawings of typical plants; a vegetation page; and a soils page. Descriptions of ecosystem phases and variations are often less detailed. Most of the information included in the ecosystem descriptions is self-explanatory, but some of the terms and symbols may require further explanation.

7.1.1 General description page

Ecological Moisture Regime: refers to the relative amount of moisture available for plant growth. The modal moisture regime of the ecosystem unit is indicated here, rather than the entire range of moisture conditions associated with the unit (the range is depicted on the edatopic grid). For a synopsis of the moisture regime classes, refer to Table 1.

Ecological Nutrient Regime: refers to the relative amount of nutrients available for plant growth. Again, the modal nutrient regime is indicated here. For a synopsis of the nutrient regime classes, refer to Table 2.

Edatopic Grid Position: the small grid indicates Ecological Moisture Regime (0-7) on its vertical axis and Ecological Nutrient Regime (A-E) on its horizontal axis. The shaded area on the grid indicates the range of moisture and nutrient conditions under which the ecosystem unit develops. Enlarged versions of the grid, properly labelled, appear in Figures 10, 11, 12, and 13.

Distribution: gives a general idea of how common the ecosystem unit is and where it occurs within the variant.

Physiographic Features: summarizes typical or common site characteristics and indicates where in the landscape one may expect to find the ecosystem unit.

7.1.2 Vegetation page

The vegetation page lists the most common or most important plant species in the ecosystem unit, and comments on relevant features of the plants. Each species is listed by a common name and by its scientific (Latin) name. Scientific and most common names correspond with those used in the publication "A Guide to Some Common Plants of the Skeena Area, British Columbia" (Coupé *et al*. 1982), which is designed to be used in conjunction with this guide. Occasionally, when a plant species immediately follows another belonging to the same genus, the name of the genus is abbreviated (e.g., *Vaccinium ovalifolium*, *V. alaskaense*). A complete list of plant species appears in Appendix 1.

The plants are listed according to strata or layers which are defined as follows:

Trees: woody plant exceeding 10 m in height. In extreme habitats, such as bogs, tree species are often stunted and less than 10 m tall. However, we still list them in the tree layer and comment on their reduced height. Note that the tree species listed represent those found in mature climax or at least advanced successional stands (unless otherwise indicated). Young stands may have a very different species composition.

Shrubs: woody plants between approximately 30 cm and 10 m in height. Note that once a species has been recorded in the tree layer, we do not list it again in the shrub layer, even if seedlings and saplings below 10 m are present. In some cases, however, we do comment on the importance of advance regeneration in the shrub layer.

Herbs: all herbaceous (non-woody) plants, including ferns, plus all trailing woody plants and dwarf shrubs that do not normally exceed 30 cm in height. For example, the dwarf shrub kinnikinnick (*Arctostaphylos uva-ursi*) is always included in the herb layer because of its low growth habit.

> Moss layer: includes mosses, liverworts, and lichens growing on the forest floor. Note that unless otherwise indicated in the comments, we do not include species growing on decaying wood or on living plants. We do not list common names for most species in this layer. However, the term feather moss is used to refer collectively to the three mosses Pleurozium schreberi, Hylocomium splendens, and Ptilium crista-castrensis; leafy mosses are all species belonging to the genus Mnium (also known as Rhizomnium or Plagiomnium). Peat moss refers to Sphagnum mosses.

Within each layer, the species are listed more or less in order of importance, although the order varies from site to site in the field. The list does not include all species found in an ecosystem unit, just those that are most common or most important in terms of cover or indicator value. Cover refers to the abundance or percentage of ground surface occupied by the plant. Indicator value refers to how much a plant can tell you about the growing conditions on the site. Some plants, like bunchberry (Cornus canadensis) are poor indicators because they will grow almost anywhere. Other plants, such as enchanter's nightshade (Circaea alpina) are very choosy about their habitat requirements and therefore are good indicators of site conditions such as moisture, nutrients, light, and climate. Where possible we have tried to specify the indicator value of a species.

Species enclosed in square brackets [ ] either have low cover, or are not consistently present. They are always less important than species without brackets.

The abbreviation "sp." after the name of a plant genus (e.g., Viola sp.) refers to a single, unknown species, while "spp." refers to several unnamed species belonging to the genus (e.g., Sphagnum spp.). Occasionally we recognize subdivisions of a species, called subspecies. These are abbreviated "ssp." (e.g., Alnus viridis ssp. sinuata).

7.1.3 Soils page

The soils page attempts to summarize those soil features that aid in classification and identification of the ecosystem unit. In many cases, soil profiles described within an ecosystem association are extremely variable. Similarities between soil features such as texture, colour, volume of coarse fragments, and depth of organic layers may aid in the identification of an ecosystem unit. The use of statements regarding nutritional status or texture of a horizon should not be taken as definite, owing to a lack of chemical or physical lab analysis of these soils. A brief description of the soil page format follows:

SOILS: includes a paragraph summarizing the basic morphological features of the soil pedon, such as colour, texture, and depth of humus. These are the features that would appear most obvious to an observer looking into the soil pit.

Soil Classification: classifies the most common soils within each ecosystem unit, based on Canadian Soil Survey Committee, Subcommittee on Soil Classification (1978).

Humus Form Classification: refers to the classification of surface organic materials and is based on Klinka et al. (1981).

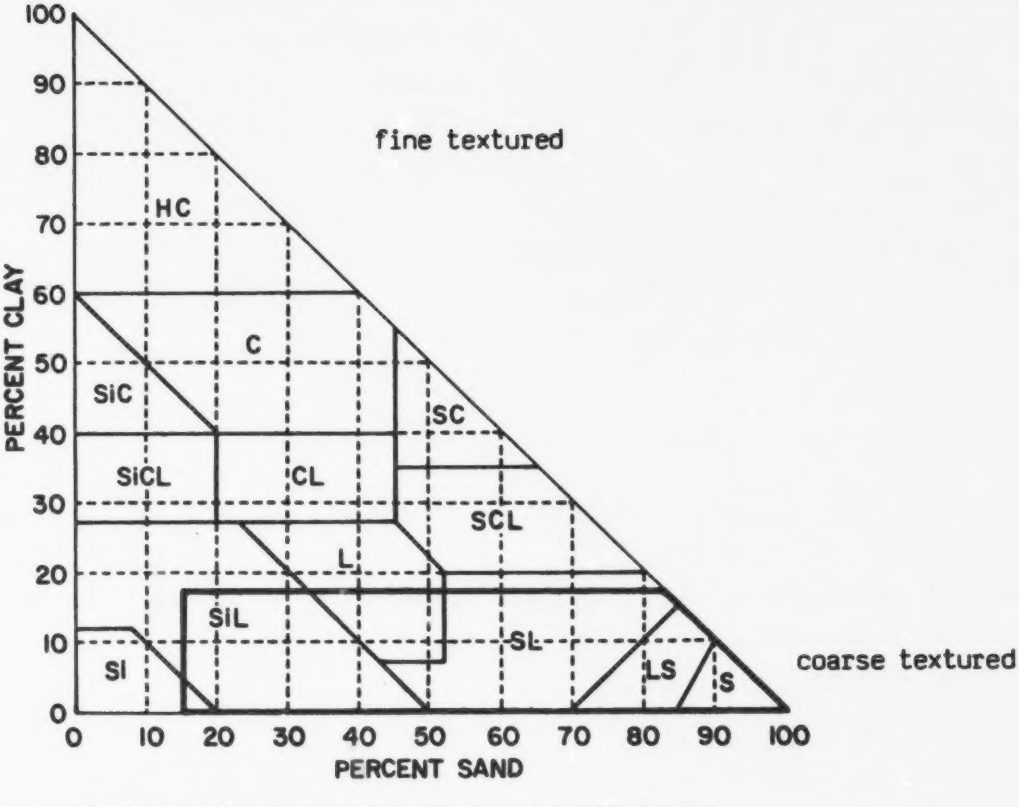
Schematic Profile: presents a simplified diagram of a "typical soil profile" within an ecosystem unit. Horizon designations and a brief description of important or dominating horizons are also given. The most important morphological features of the horizons such as colour, texture, structure, abundance of roots, presence or absence of mottling, and acidity may be mentioned. Parentheses around a horizon designation, e.g., (Bm), are used either (1) to suggest the horizon may occur, but is not the most common; or (2) in cases where two profiles are described. Parentheses around horizons correspond to the soil name in parentheses below the profile. Colour names used in profile descriptions come from the Munsell Colour Chart. For a breakdown of sand (S), silt (Si), and clay (C) into textural classes, refer to the textural triangle in Figure 9.

Average pH: mineral horizons - refers to the weighted average of pH values within the upper 50 cm of the mineral soil (or less if lithic contact occurs).

Average pH: organic horizons - refers to the weighted average of pH values for organic horizons (L,F,H) above the mineral surface, or to a maximum depth of 50 cm for non-freely drained organic soils (Of, Om, Oh).

Key Characteristics: this includes, in point form, some features that may help to identify soils of a particular ecosystem unit from other units. This section focuses on some of the key features that occur in most profiles within a particular unit.

A brief concluding section (Comments) may follow.


fine textured
coarse textured
PERCENT CLAY
PERCENT SAND
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
HC
C
SiC
SiCL
CL
SC
SCL
L
SiL
SL
Si
LS
S

Soil texture classes. Percentages of clay and sand in the main textural classes of soil; the remainder of each class is silt.

FIGURE 9. Soil textural triangle. Subdivision of the triangle into coarse and fine textured sections corresponds with family particle-size classes (Canada Soil Survey Committee 1978: Fig. 36), whereby relatively coarse textured soils have sandy or coarse-loamy family particle sizes, and everything else is relatively fine textured.

7.2 Classification of Ecosystem Units of the ICHgl: Upper Nass Basin Variant

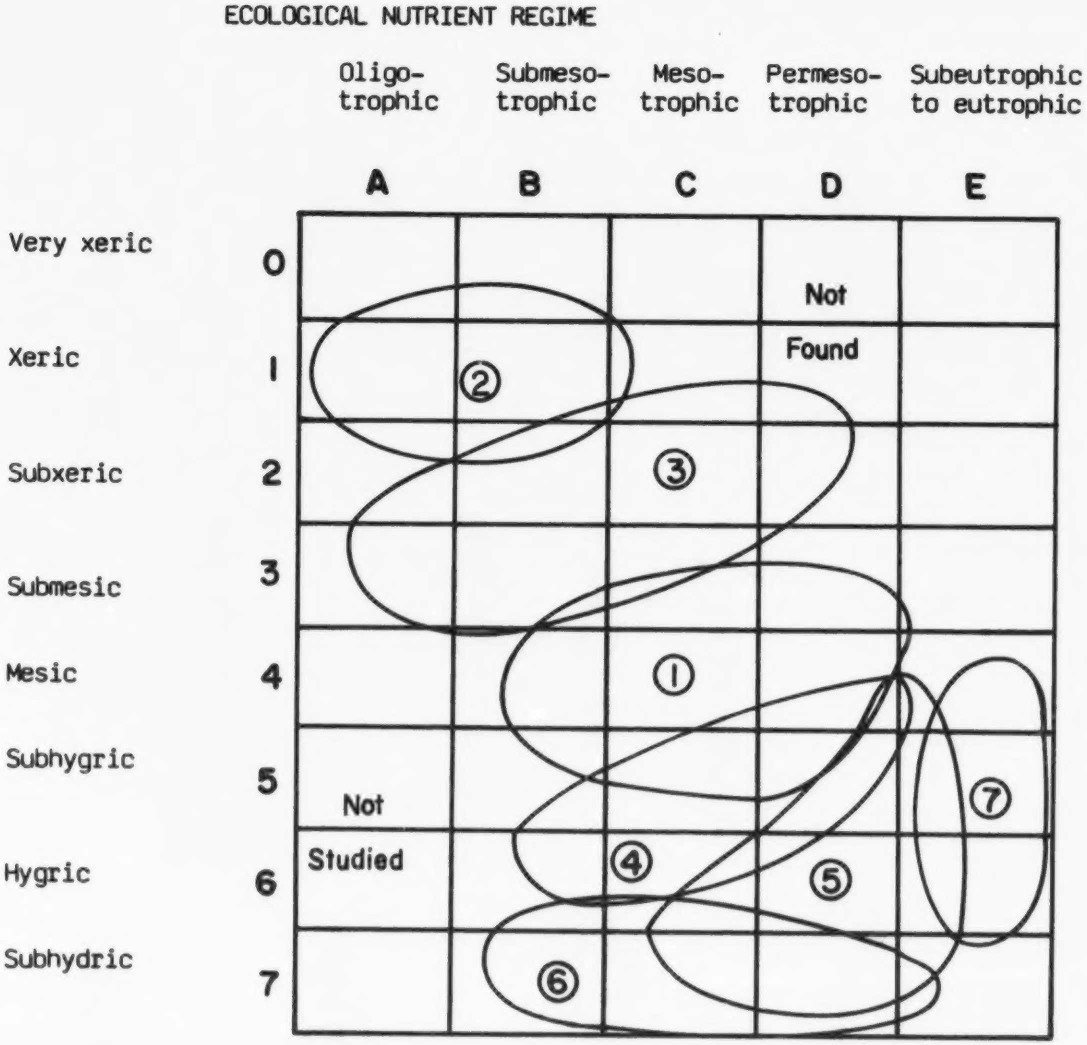
/01 Zonal hemlock - moss ecosystem association
    /01(1) Vaccinium variation
/02 Pine - lichen ecosystem association
/03 Dry hemlock - moss ecosystem association
/04 Devil's club - oak fern - feather moss ecosystem association
/05 Devil's club - fern - leafy moss ecosystem association
/06 Horsetail - (skunk cabbage) swamp ecosystem association

Seral ecosystem association:
/07 Floodplain cottonwood seral ecosystem association

Seral variations:

7.2.1 ICHgla: Upper Nass Basin Variant: Amabilis Fir Phase

/01 Zonal hemlock - amabilis fir - (Vaccinium) - moss ecosystem association
/02 Dry hemlock - moss ecosystem association
/03 Devil's club - oak fern ecosystem association
/04 Devil's club - lady fern - oak fern ecosystem association


ECOLOGICAL NUTRIENT REGIME
Oligo-trophic
Submeso-trophic
Meso-trophic
Permeso-trophic
Subeutrophic to eutrophic
A
B
C
D
E
Very xeric
0
Xeric
1
Subxeric
2
Submesic
3
Mesic
4
Subhygric
5
Hygric
6
Subhydric
7
Not Found
Not Studied
②
③
①
⑦
④
⑤
⑥

① **ZONAL HEMLOCK - MOSS**
② **PINE - LICHEN**
③ **DRY HEMLOCK-MOSS**
④ **DEVIL'S CLUB - OAK FERN - FEATHER MOSS**
⑤ **DEVIL'S CLUB - FERN - LEAFY MOSS**
⑥ **HORSETAIL - (SKUNK CABBAGE) SWAMP**
⑦ **FLOODPLAIN COTTONWOOD**

FIGURE 10. Edatopic grid of ecological moisture and nutrient regimes - ICHgl.

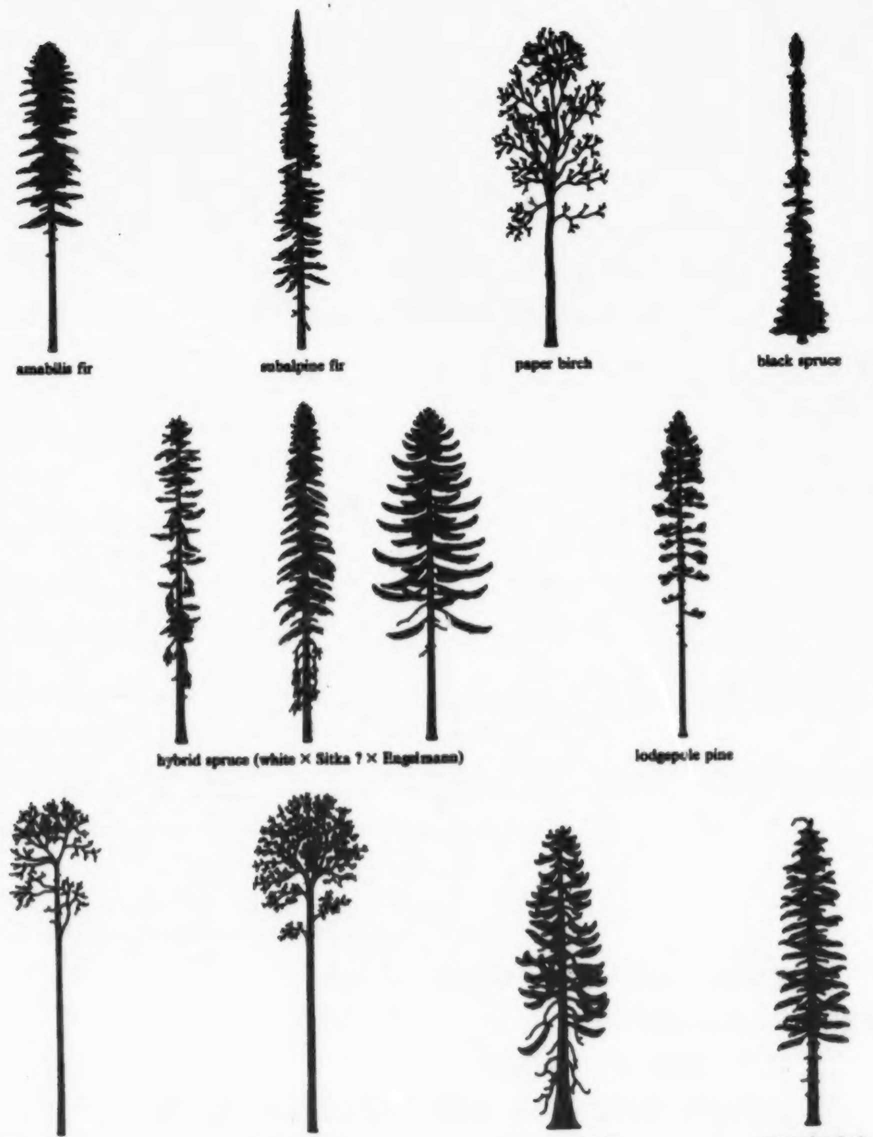
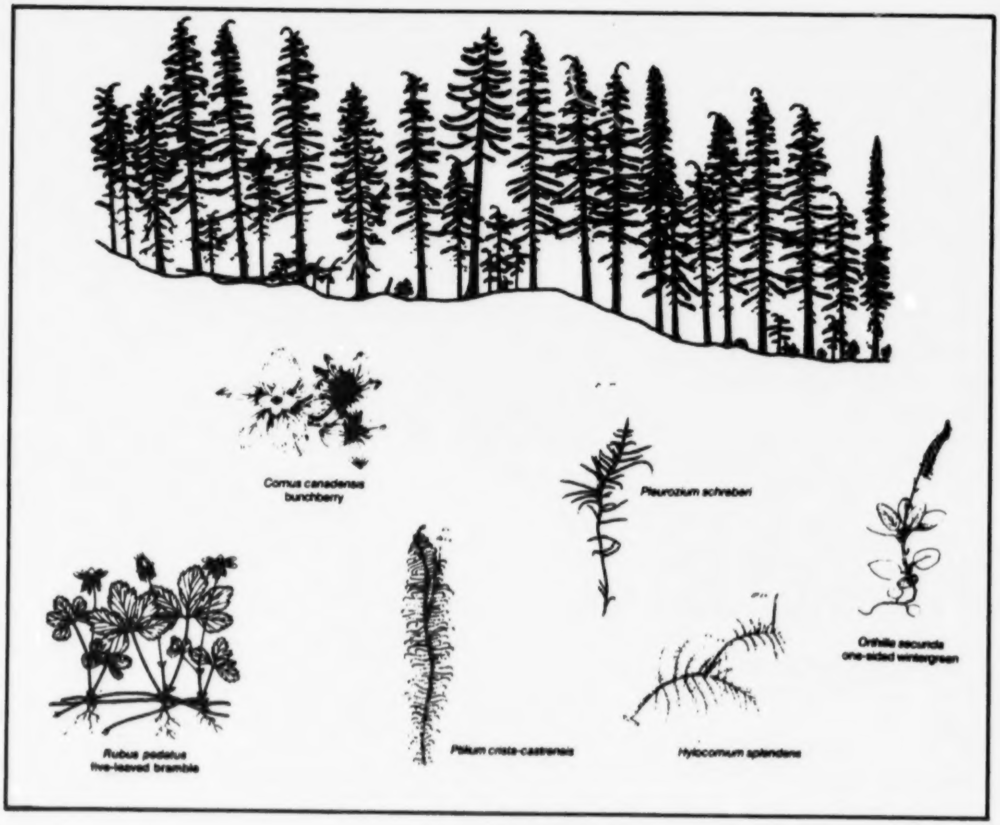
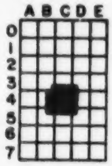

amabilis fir
subalpine fir
paper birch
black spruce
hybrid spruce (white × Sitka ? × Engelmann)
lodgepole pine
trembling aspen
black cottonwood
western redcedar
western hemlock

FIGURE 11. Tree species silhouettes used in the slope diagrams.

ICHg1: UPPER NASS BASIN VARIANT
/01 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION (206)[8]



Cornus canadensis
bunchberry
Pleurozium schreberi
Orthilia secunda
one-sided wintergreen
Rubus pedatus
five-leaved bramble
Ptilium crista-castrensis
Hylocomium splendens



A B C D E
0
1
2
3
4
5
6
7

ECOLOGICAL MOISTURE REGIME:
mesic

ECOLOGICAL NUTRIENT REGIME:
mesotrophic

DISTRIBUTION: widespread throughout most of the ICHg1, especially at lower elevations.

PHYSIOGRAPHIC FEATURES:

Slope position: middle to lower slopes, occasionally extending to upper slopes and benches; generally not moisture-shedding or receiving positions.

Slope range: gentle to moderately steep; occasionally level.

Surface shape: variable; straight, irregular, concave or convex.

Landforms: morainal blankets; some colluvial blankets; glaciofluvial deposits.

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[8] Number in parentheses is the page number of the appropriate silvicultural prescription.

ICHgl/01 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: moderately dense stands of small to medium-sized trees.

western hemlock	(Tsuga heterophylla)	
[subalpine fir	(Abies lasiocarpa)]	-frequently present; often the tallest trees
[hybrid spruce	(Picea glauca x sitchensis ?x engelmannii)]	-scattered dominants common

Shrubs: a very poorly developed layer (1-10% cover).

[black huckleberry	(Vaccinium membranaceum)]	-scattered individuals of low vigour
[oval-leaved blueberry	(Vaccinium ovalifolium)]	
[Alaskan blueberry	(Vaccinium alaskaense)]	
[false azalea	(Menziesia ferruginea)]	
[devil's club	(Oplopanax horridus)]	-individuals of low vigour frequently present in wet microsites

Herbs: a poorly developed layer (3-10% cover).

[bunchberry	(Cornus canadensis)]	
[five-leaved bramble	(Rubus pedatus)]	
[one-sided wintergreen	(Orthilia secunda)]	
[queen's cup	(Clintonia uniflora)]	-all species have sparse cover
[pink wintergreen	(Pyrola asarifolia)]	
[twistedstalks	(Streptopus amplexifolius, S. roseus]	
[rattlesnake plaintain	(Goodyera oblongifolia]	
[prince's pine	(Chimaphila umbellata)]	

Moss layer: a well-developed feather moss carpet; good vigour.

Hylocomium splendens
Pleurozium schreberi
Ptilium crista-castrensis
[Brachythecium spp.]

Remarks: The Zonal hemlock - moss ecosystem association represents the true (mesic, mesotrophic) climatic climax ecosystem of the ICHgl variant. The floristic differences between this ecosystem association and the Dry hemlock - moss e.a. (ICHgl/02) are subtle. The vegetation of both looks similar; a Hemlock - moss plant community nearly bare of shrubs and herbs. The Zonal hemlock - moss e.a. has higher diversity and vigour of understory species. We have emphasized the differences in species composition and importance in the species lists for the two ecosystem associations, but these differences may be difficult to detect in the field. Minor occurrence of species that indicate subhygric conditions, such as devil's club, twistedstalks, foamflowers, or oak fern, is a good sign of the Zonal e.a., but it cannot be depended upon.

Tree growth in the Zonal hemlock - moss e.a. generally is significantly better than in the Dry hemlock - moss e.a. Subalpine fir occurs regularly in the main canopy of the ICHgl/01 and is occasionally dominant in height. Spruce is scattered in most stands and is usually the largest, fastest growing tree. Amabilis fir, where present, achieves moderate size but appears to die back in the main canopy. Lodgepole pine is less common than in the Dry hemlock - moss e.a.

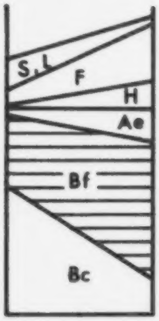
ICHg1/01 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles generally form on mid-slope positions that do not receive abundant moisture or nutrients. Podzolic profile development is most common, with loamy reddish brown (Bf) mineral horizons overlying loamy to loamy sand yellowish brown BC horizons. Olive brown mineral horizons may underlie these two horizons at depths greater than 50 cm. A leached, light brownish gray horizon, 2-5 cm thick, may overlie reddish Bf horizons. Organic horizons generally range 5-15 cm in depth with acidic Mors common.

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Orthic Humo-Ferric Podzol

Horizon	Description
S,L	- loose discontinuous litter and/or moss layer.
F	- partially decomposed; brown to dark brown; plentiful fine, medium roots; common white mycelia.
H	- well-decomposed; black; plentiful medium, coarse roots.
Ae	- light brownish gray; loam; few coarse roots.
Bf	- reddish brown to strong brown; loamy (sand); plentiful medium, fine roots.
BC	- yellowish to olive brown; loamy sand to loam; few fine roots; may contain mottles.

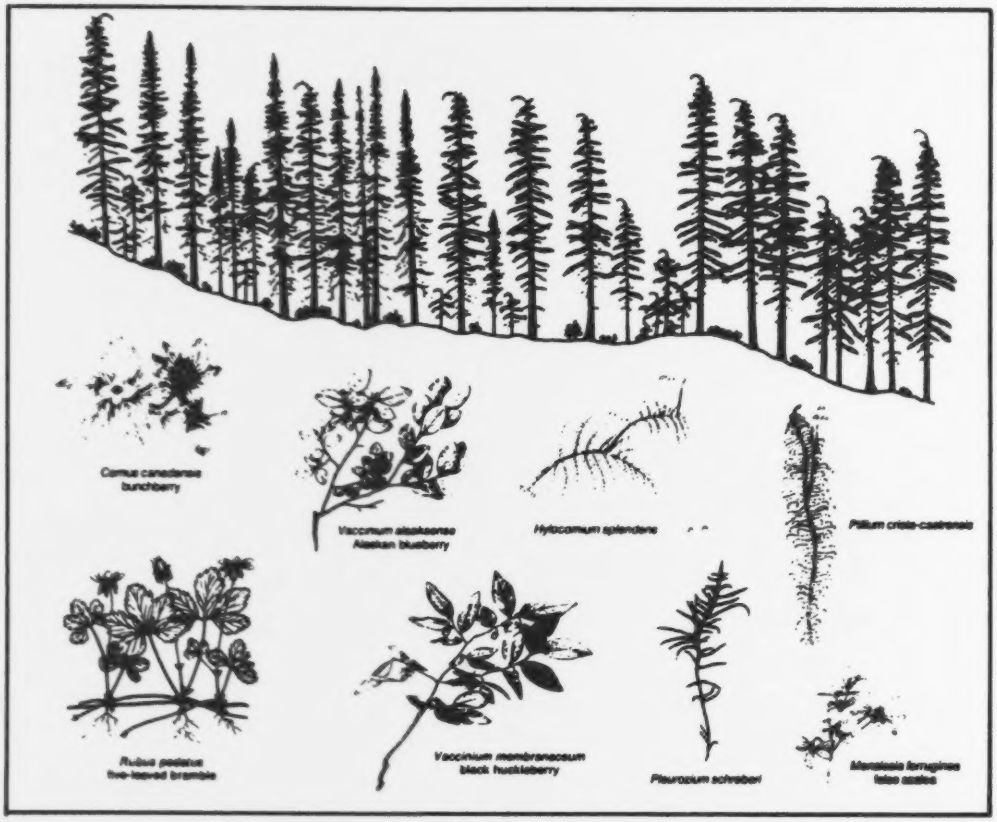
Average pH: mineral horizons - 4.5
organic horizons - 3.2

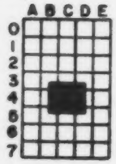
Key Characteristics:

- profiles show good podzolic development.
- relatively deep rooting (greater than 50 cm) in loamy soils.
- commonly freely drained soils although temporary seepage may result in some faint mottling at depth.
- very acidic Mor humus forms, 5-15 cm thick, well-drained and in an elementary stage of decomposition.
- lithic contacts lacking in upper 100 cm of the soil profile.

ICHgl: UPPER NASS BASIN VARIANT

/01(1) ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: VACCINIUM VARIATION (206)


Cornus canadensis
bunchberry
Vaccinium alaskaense
Alaskan blueberry
Hylocomium splendens
Ptilium crista-castrensis
Rubus pedatus
five-leaved bramble
Vaccinium membranaceum
black huckleberry
Pleurozium schreberi
Menziesia ferruginea
false azalea


A B C D E
0
1
2
3
4
5
6
7

ECOLOGICAL MOISTURE REGIME:
(submesic) - mesic
ECOLOGICAL NUTRIENT REGIME:
(submesotrophic+) - mesotrophic

DISTRIBUTION: widespread in the upper Kispiox and Kwinageese river valleys; sporadic and mainly at higher elevations in other parts of the ICHgl.

PHYSIOGRAPHIC FEATURES:
Slope position: mid-slopes, extending to upper and lower slopes; some ridges.
Slope range: gently rolling to moderately steep.
Surface shape: variable; straight, irregular, slightly convex or concave.
Landforms: morainal (colluvial) veneers and occasionally blankets; some glaciofluvial deposits.

ICHgl/01(1) ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: *VACCINIUM* VARIATION

VEGETATION:

Trees: stands usually not dense.

western hemlock	(*Tsuga heterophylla*)	
[subalpine fir	(*Abies lasiocarpa*)]	-significant component of main canopy in most stands, esp. at higher elevations

Shrubs: usually a well-developed layer (50-80% cover).

Alaskan blueberry	(*Vaccinium alaskaense*)
false azalea	(*Menziesia ferruginea*)
oval-leaved blueberry	(*Vaccinium ovalifolium*)
black huckleberry	(*Vaccinium membranaceum*)

Herbs: sparse to moderately well-developed (trace - 20% cover).

bunchberry	(*Cornus canadensis*)	)-consistently
five-leaved bramble	(*Rubus pedatus*)	) present
one-sided wintergreen	(*Orthilia secunda*)	)
[stiff club-moss	(*Lycopodium annotinum*)]	
[pink wintergreen	(*Pyrola asarifolia*)]	
[twinflower	(*Linnaea borealis*)]	
[small twistedstalk	(*Streptopus streptopoides*)]	-especially at higher elevations

Moss layer: a well-developed, continuous carpet of feather mosses.

Pleurozium schreberi
Hylocomium splendens
Ptilium crista-castrensis
Brachythecium spp.
Barbilophozia spp.

Remarks: The dominant visual feature of this ecosystem variation is the well-developed layer of *Vaccinium* (and false azalea) shrubs. Aside from its shrub layer, there is little that differentiates the *Vaccinium* variation from the typical Hemlock - moss found on zonal sites throughout most of the ICHgl. We do not fully understand why the variation is present in some areas while in others it is not. The presence of the shrub layer may reflect higher precipitation levels (especially snow) than are present in most areas of the ICHgl. The *Vaccinium* variation seems especially common at higher elevations and this supports the theory that the depth of snowpack is somehow responsible. Stand structure also affects the development of the shrub layer. Many of the stands belonging to the *Vaccinium* variation have a more open canopy than typical Hemlock - moss stands. In denser stands the shrubs may be excluded because of lack of light. Stand density may reflect sucessional status but it is likely that climate and site factors are also involved.

Until we have a better understanding of the differences between the typical Zonal hemlock - moss ecosystem association (ICHgl/01) and the Vaccinium variation and how they affect tree establishment and growth, we will treat these two ecosystem units together for management purposes.

ICHg1/01(1) ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: VACCINIUM VARIATION

SOILS: Most of the soils of this variation have developed on morainal veneers overlying bedrock in varied slope positions. Such shallow soils are well-drained, have undergone intense leaching, and show good profile development. A thick, light brownish-gray surface mineral horizon (Ae) between 3 and 15 cm thick is found above dark reddish-brown (Bhf) and/or yellowish brown (Bf) mineral horizons of loamy texture. Organic materials have accumulated to depths ranging from 5 to 11 cm with fungal (F) decomposition predominant.

Soil Classification: Orthic Humo-Ferric Podzols with minor occurrences of Gleyed Podzolic Gray Luvisols.

Humus Form Classification: Orthihemimors.

Schematic Profile: refer to profile description under Zonal hemlock - moss ecosystem association (ICHg1/01).

Average pH: mineral horizons - 4.3
organic horizons - 3.1

Key Characteristics:

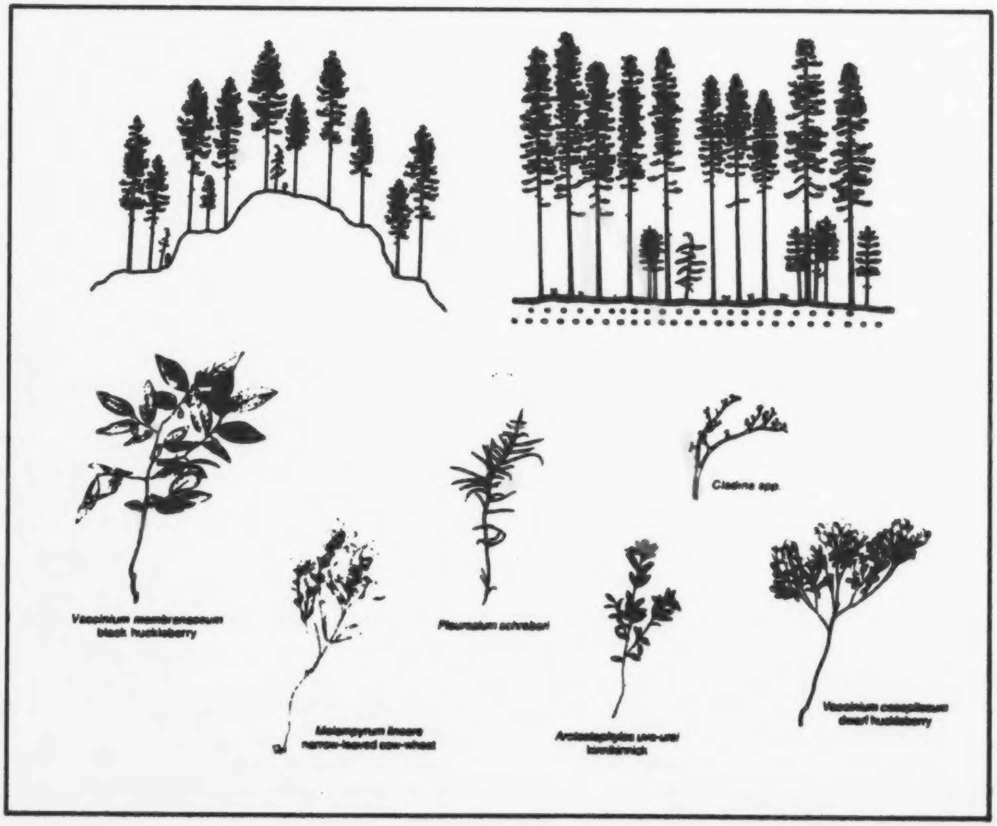
- shallow soils with bedrock commonly within 60 cm of the mineral surface.
- dominantly well-drained, loamy soils.
- subsurface horizons have a relatively low coarse fragment content.
- thick, light brownish gray Ae horizons are present at the mineral surface.
- occasional accumulation of organic matter in surface mineral horizons (Bhf) may improve moisture and nutrient storage.
- mottles may be found in subsurface horizons of the deeper morainal deposits.
- effective rooting shallow (30 - 50 cm) or to bedrock.

ICHgl: UPPER NASS BASIN VARIANT

/02 PINE - LICHEN ECOSYSTEM ASSOCIATION (207)

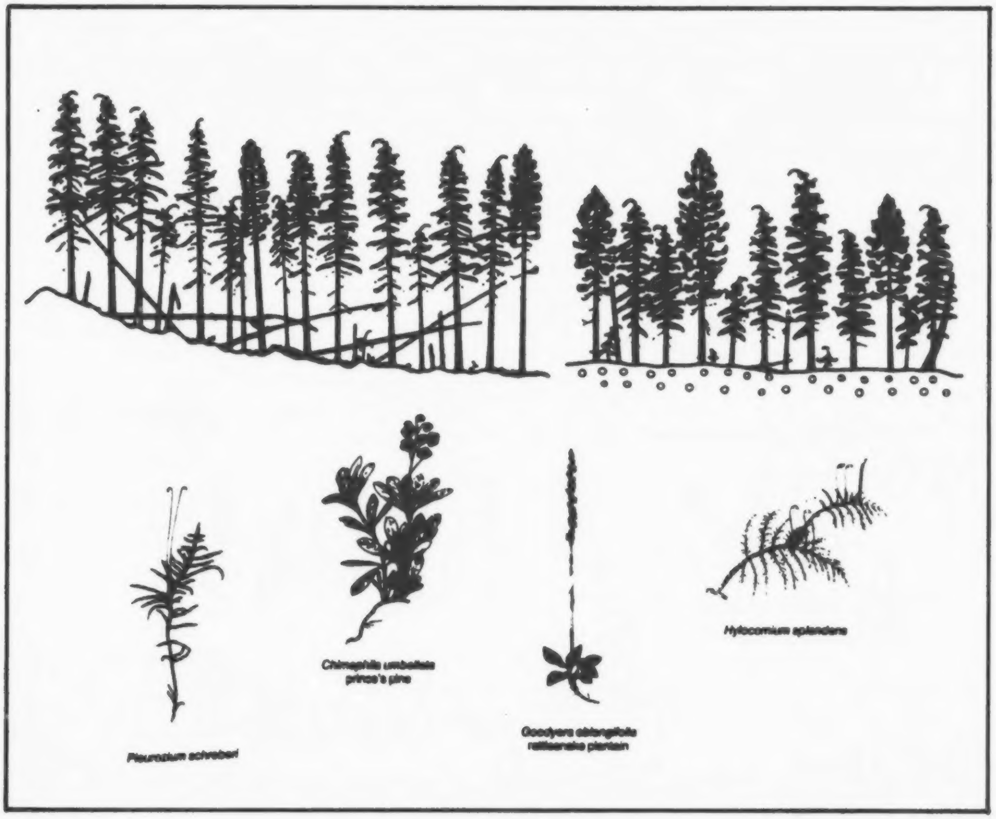
Remarks: This ecosystem association has a very limited distribution in the ICHgl variant and is unimportant for forest management. It includes ecosystems on the very driest and nutrient-poorest rock outcrops, ridges, and outwash terraces where lodgepole pine is maintained by repeated fire. Most dry pine stands in the ICHgl do not belong to this seral ecosystem association, but merely represent seral stages of the Dry hemlock - moss e.a. (ICHgl/03).

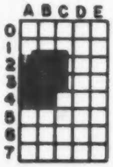
For a complete description and management interpretations of the Pine-lichen e.a. refer to the corresponding ecosystem unit in the g3 (Hazelton) variant (ICHg3/02).


Vaccinium membranaceum
black huckleberry
Pleurozium schreberi
Cladina spp.
Melampyrum lineare
narrow-leaved cow-wheat
Arctostaphylos uva-ursi
kinnikinnick
Vaccinium caespitosum
dwarf huckleberry

ICHg1: UPPER NASS BASIN VARIANT

/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION (208)


Pleurozium schreberi
Chimaphila umbellata
prince's pine
Goodyera oblongifolia
rattlesnake plantain
Hylocomium splendens



ECOLOGICAL MOISTURE REGIME:
(subxeric) - submesic
ECOLOGICAL NUTRIENT REGIME:
submesotrophic

DISTRIBUTION: widespread throughout the ICHg1, especially at lower elevations.

PHYSIOGRAPHIC FEATURES:

Slope position: upper slopes and ridge crests, some terraces and benches; generally moisture-shedding positions.
Slope range: level to moderately steep (0 - 45%+).
Surface shape: usually convex, occasionally straight or irregular.
Landforms: morainal (colluvial) veneers over bedrock; some morainal blankets; coarse textured glaciofluvial and fluvial deposits.

ICHgl/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: usually a dense canopy formed by small, short trees.

western hemlock	(*Tsuga heterophylla*)	-dominant cover
[lodgepole pine	(*Pinus contorta*)]	-usually scattered, overmature dominants
[subalpine fir	(*Abies lasiocarpa*)]	-small, scattered, below main canopy

Shrubs: a very poorly developed layer; advance regeneration of trees usually very poor.

[black huckleberry	(*Vaccinium membranaceum*)]	)
[oval-leaved blueberry	(*Vaccinium ovalifolium*)]	)-scattered
[Alaskan blueberry	(*Vaccinium alaskaense*)]	) individuals of
[false azalea	(*Menziesia ferruginea*)]	) very low vigour
[falsebox	(*Paxistima myrsinites*)]	)

Herbs: very poorly developed layer (less than 1 to 4% cover).

[prince's pine	(*Chimaphila umbellata*)]	)
[rattlesnake plaintain	(*Goodyera oblongifolia*)]	)
[bunchberry	(*Cornus canadensis*)]	)-scattered
[one-sided wintergreen	(*Orthilia secunda*)]	) individuals or
[five-leaved bramble	(*Rubus pedatus*)]	) small groups
[twinflower	(*Linnaea borealis*)]	)
[pinesap	(*Hypopitys monotropa*)]	)

Moss layer: a well-developed solid carpet of feather mosses; low diversity.

Pleurozium schreberi	-usually dominates sites on the driest
Hylocomium splendens	-usually dominates on slightly moister sites
[*Ptilium crista-castrensis*]	

Remarks: The Dry hemlock - moss ecosystem association is usually distinctly drier and poorer than the Zonal hemlock - moss e.a., but intermediate sites need to be carefully examined. Soils and moisture status of the site must be assessed before an ecosystem can be placed within this unit. The productivity of tree species is often noticeably lower than in the Zonal hemlock - moss e.a. Subalpine fir is restricted to subcanopy layers and amabilis fir in valleys such as the Kinskuch; also rarely reaches the main canopy. Spruce is extremely rare, and shows very poor growth rates when present. Pine often dominates young stands and attains the greatest height of all trees. In mature stands, the crowns of overmature pines extend above the main canopy of hemlock.

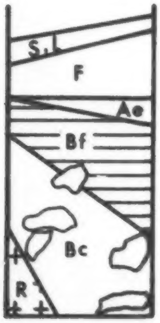
ICHg1/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles have developed mainly in upper slope positions, where available moisture may be lacking. This is true especially in shallow soils having bedrock intrusions within 50 cm of the mineral surface. Loamy to loamy sand, strong brown, mineral horizons (Bf, Bm) dominate the upper 30 cm of the mineral soil. These modified horizons are often underlain by a yellowish-brown silt loam to clay loam horizon containing variable amounts of coarse fragments. Relatively thin organic horizons (4-10 cm) reflect the slightly drier conditions and reduced litter fall.

Soil Classification: Orthic Humo-Ferric Podzols and Eluviated Dystric Brunisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
S,L	- moss layer and loose, undecomposed, discontinuous litter.
F	- slightly to moderately decomposed; brown; contains common fungal mycelia; plentiful fine roots.
Bf	- yellowish-brown to strong brown; loamy sand to loam; plentiful medium, coarse roots; variable coarse fragment content.
BC	- yellowish-brown; sand to clay loam; few to plentiful fine roots; subangular blocky structure.

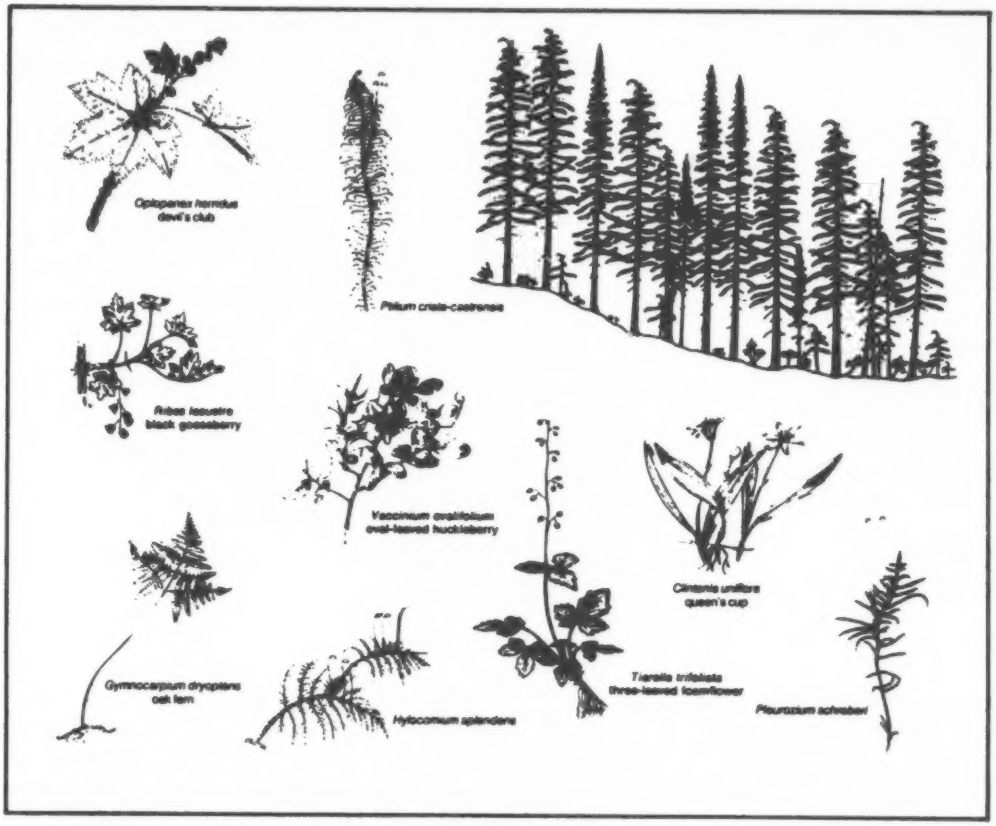
Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.6
organic horizons - 3.3

Key Characteristics:
- soils generally occur on crest and upper slope positions.
- generally shallow, well-drained soils.
- subsurface mineral horizons of clayey texture may become hard when dry.
- organic materials are relatively weakly decomposed (freely drained), acidic, and thin.
- effective rooting generally deep (greater than 60 cm) or to lithic contact.

ICHg1: UPPER NASS BASIN VARIANT

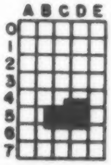
/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION (209)



Oplopanax horridus
devil's club
Ptilium crista-castrensis
Ribes lacustre
black gooseberry
Vaccinium ovalifolium
oval-leaved huckleberry
Clintonia uniflora
queen's cup
Gymnocarpium dryopteris
oak fern
Hylocomium splendens
Tiarella trifoliata
three-leaved foamflower
Pleurozium schreberi

ECOLOGICAL MOISTURE REGIME:
(mesic+) - subhygric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic



DISTRIBUTION: widely distributed throughout the ICHgl, but less extensive, more localized than the Zonal hemlock - moss e.a.

PHYSIOGRAPHIC FEATURES:
Slope position: middle to lower slopes (rarely upper slopes); valley floors.
Slope range: gentle to moderately sloping; occasionally flat.
Surface shape: smooth and straight - irregular concave; rarely convex.
Landforms: fluvial (glaciofluvial) deposits; morainal and colluvial blankets, often washed.

ICHgl/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: relatively open stands; irregular canopy.

western hemlock	(*Tsuga heterophylla*)	-usually dominates cover
subalpine fir	(*Abies lasiocarpa*)	-dominant cover in many stands
hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	-consistently present; tallest tree

Shrubs: a moderately well-developed layer.

devil's club	(*Oplopanax horridus*)	-consistently present but rarely dominates shrub layer
black gooseberry	(*Ribes lacustre*)	-consistently present but inconspicuous
oval-leaved blueberry	(*Vaccinium ovalifolium*)	
black huckleberry	(*Vaccinium membranaceum*)	
false azalea	(*Menziesia ferruginea*)	
[thimbleberry	(*Rubus parviflorus*)]	)-good indicators
[highbush-cranberry	(*Viburnum edule*)]	) when present; more frequent in seral stands

Herbs: moderately to well-developed layer; fairly diverse.

oak fern	(*Gymnocarpium dryopteris*)	-characteristic dominant
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	-good indicator species
bunchberry	(*Cornus canadensis*)	)-very common, good
five-leaved bramble	(*Rubus pedatus*)	) vigour, but not
one-sided wintergreen	(*Orthilia secunda*)	) good indicator species
queen's cup	(*Clintonia uniflora*)	
[heart-leaved twayblade	(*Listera cordata*)]	
[twistedstalks	(*Streptopus amplexifolius*, *S. roseus*)]	

Moss layer: a moderately well-developed feather moss carpet, but poorly developed in depressions.

Hylocomium splendens	
Ptilium crista-castrensis	
Pleurozium schreberi	
[*Rhytidiadelphus triquetrus*]	
[*Mnium* spp.]	-in wetter depressional microsites

Remarks: Both subalpine fir and spruce are significantly more important in this ecosystem association than in the Zonal hemlock-moss e.a. Their productivity is greater than that of hemlock, although there is high natural mortality of subalpine fir in many stands. Note that even though devil's club and oak fern are the important indicator plant species of this ecosystem association, they rarely totally dominate the understory vegetation. A carpet of feather mosses is still a noticeable feature. Lady fern and spiny wood fern are rarely present and then only as small individuals in wet pockets.

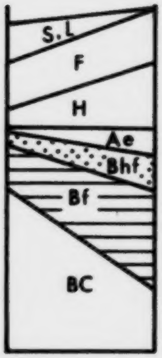
ICHgl/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles develop in positions receiving more moisture than mesic sites. Soils may or may not show mottling and/or gleyed colours but, in general, all soils provide adequate moisture throughout the growing season. Dark yellowish brown mineral horizons (Bf, Bm) commonly develop above deep, loamy to sandy textured, fluvial and washed morainal deposits. Many subsurface horizons (below 40 cm) are imperfectly to poorly drained, with abundant mottles and seepage. Evidence of both fungal and zoogenous activity can be found in organic layers, which are primarily Mors and Moders. Organic horizons may reach depths up to 20 cm.

Soil Classification: dominantly Orthic Humo-Ferric Podzols and Gleyed Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors and Orthimormoders.

Schematic Profile:



Orthic Humo-Ferric Podzol
(Gleyed Humo-Ferric Podzol)

Horizon	Description
F	- moderately decomposed; dark brown organic layer; plentiful fine, medium roots; fungal mycelia and/or insect droppings.
H	- well-decomposed; black; plentiful medium, coarse roots; blocky to massive.
Ae	- pale brown; sandy loam; few roots; acidic.
Bhf	- dark reddish brown; loam; abundant medium, coarse roots; granular.
Bf	- dark yellowish brown; sandy to loamy; plentiful medium roots.
BC	- yellowish brown to olive brown; sandy to loamy; few fine roots; mottles may occur.

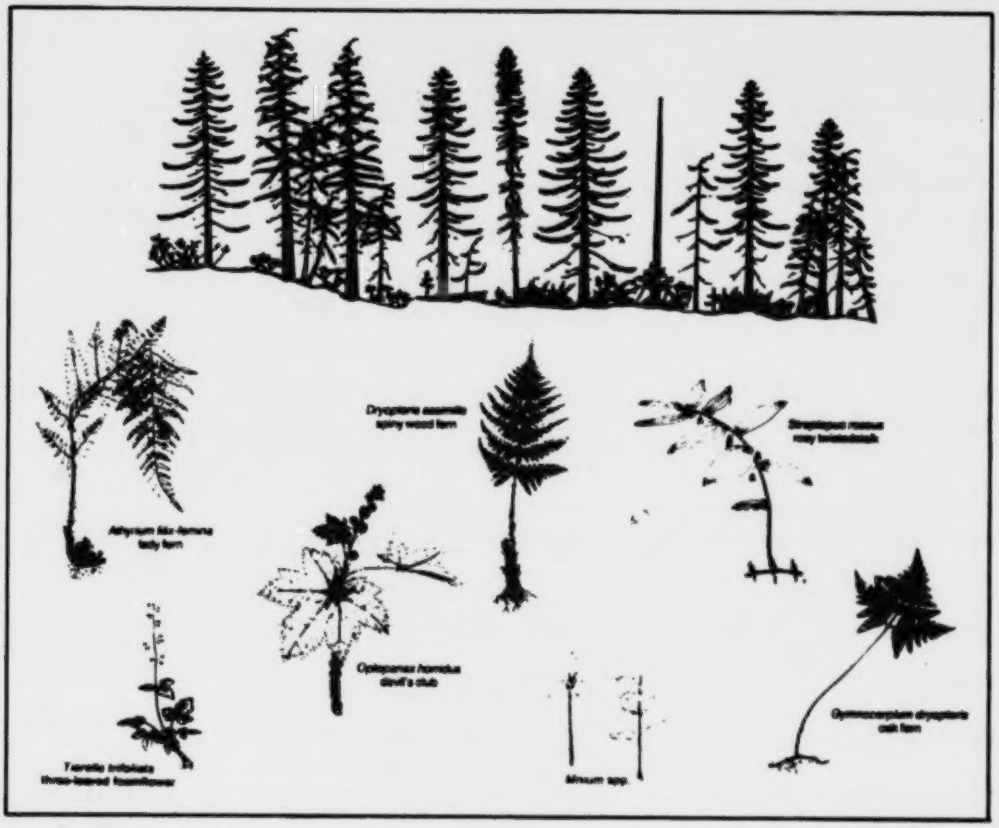
Average pH: mineral horizons - 5.0
organic horizons - 3.5

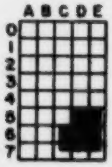
Key Characteristics:

- seepage may be found at depths greater than 40 cm from the mineral surface.
- fluvial or washed morainal deposits have deep effective rooting.
- finer textured soils of this ecosystem association generally have shallow rooting depths and a lack of pores for free air and water movement.
- organic layers are often thicker than those of mesic ecosystems.

ICHgl: UPPER NASS BASIN VARIANT

/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION (210)


Athyrium filix-femina
lady fern
Dryopteris assimilis
spiny wood fern
Streptopus roseus
rosy twistedstalk
Oplopanax horridus
devil's club
Tiarella trifoliata
three-leaved foamflower
Mnium spp.
Gymnocarpium dryopteris
oak fern


A B C D E
0
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ECOLOGICAL MOISTURE REGIME:
subhygric - hygric

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - (eutrophic)

DISTRIBUTION: common throughout the ICHgl, but more frequent at lower elevations. Stands are rarely of large extent.

PHYSIOGRAPHIC FEATURES:
Slope position: lower and toe slopes, depressions or gulleys, valley floors; positions receiving abundant seepage.
Slope range: flat to gently sloping (0-20%).
Surface shape: concave, irregular, or smooth; frequently hummocky.
Landforms: fluvial or washed morainal; (lacustrine).

ICHgl/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: stands open; canopies irregular; trees large.

subalpine fir	(*Abies lasiocarpa*)	
hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	
[western hemlock	(*Tsuga heterophylla*)]	-primarily an understory tree

Shrubs: a well-developed layer, especially tall and dense in stand openings.

devil's club	(*Oplopanax horridus*)	-usually totally dominates
black gooseberry	(*Ribes lacustre*)	
oval-leaved blueberry	(*Vaccinium ovalifolium*)	-confined to hummocks and decaying wood
red-osier dogwood	(*Cornus sericea*)	-a good indicator
highbush-cranberry	(*Viburnum edule*)	
thimbleberry	(*Rubus parviflorus*)	

Herbs: a well-developed, lush layer; diverse.

oak fern	(*Gymnocarpium dryopteris*)	-dominates on most sites
spiny wood fern	(*Dryopteris assimilis*)	
lady fern	(*Athyrium filix-femina*)	-dominant on wettest, richest sites
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
twistedstalks	(*Streptopus roseus*, *S. amplexifolius*)	
five-leaved bramble	(*Rubus pedatus*)	)-excellent vigour, usually confined to elevated microsites
bunchberry	(*Cornus canadensis*)	)
[violets	(*Viola* spp.)]	)-excellent indicator species when present
[enchanter's nightshade	(*Circaea alpina*)]	)

Moss layer: poorly developed; leafy (*Mnium*) mosses dominate, feather mosses confined to decaying wood and hummocks.

Mnium spp.
Brachythecium spp.

Remarks: This is a very productive ecosystem association for spruce and subalpine fir. By comparison, hemlock grows rather poorly and is confined to subcanopy layers and elevated microsites. The productive capacity of these sites is high, but timber volumes in existing old-growth stands are often low because of low stocking levels. There are many openings in the stands occupied by herbs and brush and there are often large numbers of snags. Advance regeneration of conifers is usually sparse and confined to decaying wood and other elevated microsites where competition with herbs and shrubs is not severe.

The Devil's club - fern - leafy moss e.a. can be distinguished from the drier, less rich Devil's club - oak fern - feather moss e.a. by:

1. predominance of spruce and subalpine fir over hemlock.
2. heavy cover of devil's club.
3. presence of lady fern and spiny wood fern along with oak fern.
4. dominance of leafy (*Mnium*) mosses with feather moss confined to decaying wood and hummocks.

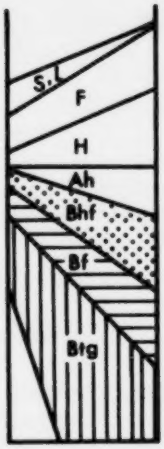
ICHg1/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

SOILS: Both mineral and organic horizons are relatively rich, with higher pH and/or seepage waters. Soils have developed primarily on moisture - receiving, lower or toe slope positions. Dark brown mineral horizons occur near the surface of most soils (Ah, Bhf). These dark colours are indicative of soluble organic materials accumulating downslope. Compacted till may be found at depth, and mottles are common in subsurface mineral horizons. Organic materials are generally in an advanced stage of decomposition (H horizon predominating) and range in thickness from 5 to 20 cm.

Soil Classification: Orthic Gleysols and Gleyed subgroups of Luvisols and Podzols; also Orthic Eutric Brunisols.

Humus Form Classification: Amphimormoders; Orthihemihumimors.

Schematic Profile:



Horizon	Description
F	- weakly to moderately decomposed; brown to dark brown organic horizon; abundant fine, medium roots; very moist; contains insect and/or fungal mycelia.
H	- well-decomposed; black organic horizon; plentiful medium, coarse roots; very moist to wet.
Ah	- dark brown; silt loam; has high organic content; granular structure; abundant medium, coarse roots.
Bhf	- dark reddish-brown; loam; subangular blocky structure; plentiful fine, medium roots.
Btg	- brownish-gray; silty clay loam; few to abundant mottles; angular blocky to massive; few fine roots; few to abundant clay films.

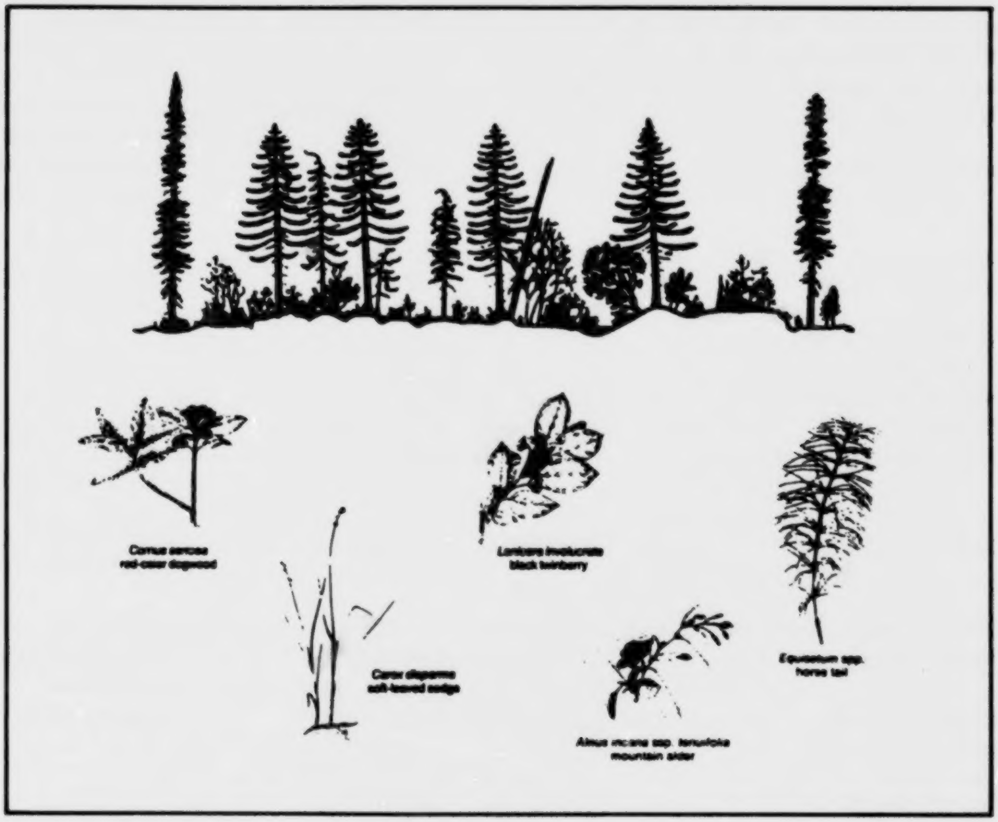
Gleyed Podzolic Gray Luvisol

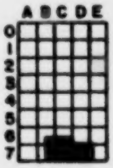
Average pH: mineral horizons - 5.1
organic horizons - 4.7

Key Characteristics:
- all soils are relatively rich, and very moist to wet for most of the growing season.
- seepage is common.
- all soil profiles sampled had surface mineral horizons (Ah, Bhf) enriched in organic matter, which aids in the retention of nutrients and water.
- effective rooting is fairly shallow (less than 35 cm) and restricted to upper, well-drained mineral horizons.
- massive or cemented layers often impede water flow fairly close to the mineral surface.

ICHg1: UPPER NASS BASIN VARIANT

/06 HORSETAIL - (SKUNK CABBAGE) SWAMP ECOSYSTEM ASSOCIATION (211)


Cornus sericea
red-osier dogwood
Lonicera involucrata
black twinberry
Carex disperma
soft-leaved sedge
Alnus incana ssp. tenuifolia
mountain alder
Equisetum spp.
horse tail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ECOLOGICAL MOISTURE REGIME:
hygric+ - subhydric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic

DISTRIBUTION: found throughout most of the ICHg1, primarily at lower elevations; not common, and generally restricted to small pockets.

PHYSIOGRAPHIC FEATURES:
Slope position: depressions on valley floor or slope benches; positions that receive or collect abundant moisture.
Slope range: level (0 - 2%).
Surface shape: flat to concave, often very hummocky.
Landforms: organic veneers over fluvial, lacustrine, or morainal deposits.

ICHgl/06 HORSETAIL - (SKUNK CABBAGE) SWAMP ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: stocking irregular, many stand openings; trees small to medium sized, confined to hummocks.

subalpine fir	(*Abies lasiocarpa*)	
hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	-dominant cover in some stands
western hemlock	(*Tsuga heterophylla*)	-primarily in subcanopy layers

Shrubs: cover variable, well-developed in stand openings.

mountain alder	(*Alnus incana* ssp. *tenuifolia*)	-characteristic constant
black twinberry	(*Lonicera involucrata*)	
highbush-cranberry	(*Viburnum edule*)	
red-osier dogwood	(*Cornus sericea*)	
[false azalea	(*Menziesia ferruginea*)]	)-often significant
[oval-leaved blueberry	(*Vaccinium ovalifolium*)]	) cover but confined to elevated microsites
[devil's club	(*Oplopanax horridus*)]	-consistently present but minor

Herbs: a well-developed layer; diverse and variable species condition.

horsetails	(*Equisetum arvense*, *E. sylvaticum*, *E. pratense*)	-characteristic constant
skunk cabbage	(*Lysichiton americanum*)	-not always present
lady fern	(*Athyrium filix-femina*)	
oak fern	(*Gymnocarpium dryopteris*)	
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
bunchberry	(*Cornus canadensis*)	)-prominent on
five-leaved bramble	(*Rubus pedatus*)	) hummocks
one-sided wintergreen	(*Orthilia secunda*)	)
[soft-leaved sedge	(*Carex disperma*)]	-an excellent indicator when present

Moss layer: variable, generally well-developed; feather mosses on hummocks.

Hylocomium splendens	-dominant on hummocks
Mnium spp.	-dominant in wet hollows
[*Sphagnum* spp.]	

Remarks: Tree growth in the Horsetail - (skunk cabbage) swamp ecosystem association is restricted by the high water table and poor soil aeration. Spruce and subalpine fir grow quite well when rooted in a favourable microsite (usually along the margins of the swamp), but hemlock grows very slowly in decaying wood or on mounds of organic matter.

Swamps with a heavy cover of skunk cabbage are found in western parts of the ICHgl, bordering on the Coastal Western Hemlock Zone (CWH), but over most of the ICHgl skunk cabbage is not common. Abundance of horsetail or soft-leaved sedge is a more reliable indicator.

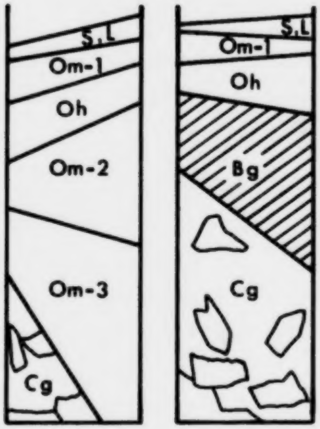
ICHgl/06 HORSETAIL - (SKUNK CABBAGE) SWAMP ECOSYSTEM ASSOCIATION

SOILS: Soils within this ecosystem association are saturated with water for prolonged or indefinite periods of the growing season. Rooting is often impeded in both poorly aerated surface organic layers (Of, Om, Oh) and subsurface mineral and/or organic horizons, due to standing water. Wet and compacted dark grayish brown to olive subsurface mineral horizons are generally found within 50 cm of the soil surface. Intense mottling and seepage generally occur within 30 cm of the mineral surface.

Soil Classification: Orthic Gleysols and Terric Mesisols.

Humus Form Classification: Fermihistomor and Fermihydromor.

Schematic Profile:



Terric Mesisol   Orthic Gleysol

Horizon	Description
S,L	- moss plus wet litter.
Om-1	- moderately to poorly aerated; moderately decomposed; dark brown; wet; few to plentiful roots.
Oh	- poorly aerated; advanced stage of decomposition; very dark brown.
Bg	- brownish gray; clay loam; common mottles; few, medium roots; angular to massive; wet.
Om-2	- subsurface organic horizon; black; wet and mucky; very few roots.
Cg	- olive gray; clay loam; abundant mottles and/or seepage; massive; wet.
Om-3	- saturated organic layer; black; seepage or standing water common.

Average pH: mineral horizons - 4.9 (limited data)
organic horizons - 4.9 (limited data)

Key Characteristics:

- occur at the base (toe) of slope, or in depressions.
- thick, wet organic layers cover the soil surface.
- majority of roots are within the upper 10-20 cm of the soil surface.
- compacted, fine textured, subsurface mineral horizons (Cg) are common.
- frequent high water table and seepage (plus mottles in mineral soils).

Comments: The excessive moisture and mucky nature of these poorly aerated organic and/or mineral soils severely restricts root development and reduces trafficability.

ICHg1: UPPER NASS BASIN VARIANT

/07 FLOODPLAIN COTTONWOOD SERAL ECOSYSTEM ASSOCIATION (212)

Remarks: Stands of cottonwood are found on the active floodplains of the upper Nass, Skeena and Kispiox Rivers and a few of their major tributaries in the ICHg1, but they are neither as common nor as extensive as on the lower reaches of these rivers. The description and management interpretations of the Floodplain cottonwood seral ecosystem association in the ICHg3 variant (ICHg3/11) also apply well to the floodplains found in the ICHg1. Note that in the ICHg1, cedar is absent and not recommended for introduction, whereas subalpine fir is more abundant and has better vigour than in the ICHg3.

ICHg1: UPPER NASS BASIN VARIANT

SERAL VARIATIONS

Remarks: Throughout much of the ICHg1, successional stands are either of minor occurrence or they bear a strong resemblance to the climax condition. However, in some low elevation or southern portions of the variant, such as along the Nass River just north of Cranberry junction and in the Kispiox valley, seral stands are widespread.

The composition of these seral stands is highly variable. Tree cover is dominated by various combinations of lodgepole pine, subalpine fir, spruce, aspen, paper birch, or black cottonwood. Pine tends to dominate on sites belonging to the Pine - lichen (ICHg1/02) e.a. and Dry hemlock - moss (ICHg1/03) e.a., while moister ecosystems contain more deciduous species and spruce.

There is a general tendency for seral variations of a given ecosystem unit to have much better developed shrub and herb layers than the climax. The diversity of species is also greater because many light or nutrient - demanding plants are still present in seral vegetation. Typical shrubs include thimbleberry (Rubus parviflorus), Saskatoon (Amelanchier alnifolia), soopolallie (Shepherdia canadensis), prickly rose (Rosa acicularis) and highbush-cranberry (Viburnum edule). Heart-leaved arnica (Arnica cordifolia), dwarf blueberry (Vaccinium caespitosum), ricegrasses (Oryzopsis asperifolia, O. pungens), trailing raspberry (Rubus pubescens), wild sarsaparilla (Aralia nudicaulis), purple peavine (Lathyrus nevadensis), star-flowered false Solomon's-seal (Smilacina stellata), and mountain sweet-cicely (Osmorhiza chilensis) are characteristic herbs of the seral stands.

In many stands, particularly those in the latter stages of succession, the successional trend is evident. Hemlock regeneration is common in understory layers, climax shrubs and herbs predominate, and a carpet of feather mosses may be the dominant feature of the forest floor. When stands of this nature are encountered in the field, classify them according to the expected climax ecosystem association and refer to the silvicultural interpretation for that ecosystem unit. Note, however, that the brush hazard of the site is often significantly increased because of the presence of deciduous trees and seral shrub species. Undesirable advance regeneration of subalpine fir may also be present and may create a regeneration problem after logging.

Other seral stands give no obvious indication of their successional trend. It is difficult to imagine them evolving into, for example, a Hemlock - moss or Devil's club - oak fern - feather moss climax. These are primarily stands with a high component of deciduous overstory, very dense shrub and herb layers, and little or no moss layer. Such seral stands are most common at the south end of the ICHg1, adjacent to the ICHg3. Red-osier dogwood (Cornus sericea) or hazelnut (Corylus cornuta) may be present in the shrub layer. When stands of this nature are encountered in the field please locate an appropriate ecosystem description of a seral ecosystem association in the ICHg3 variant, and refer to the management interpretations for that ecosystem unit.

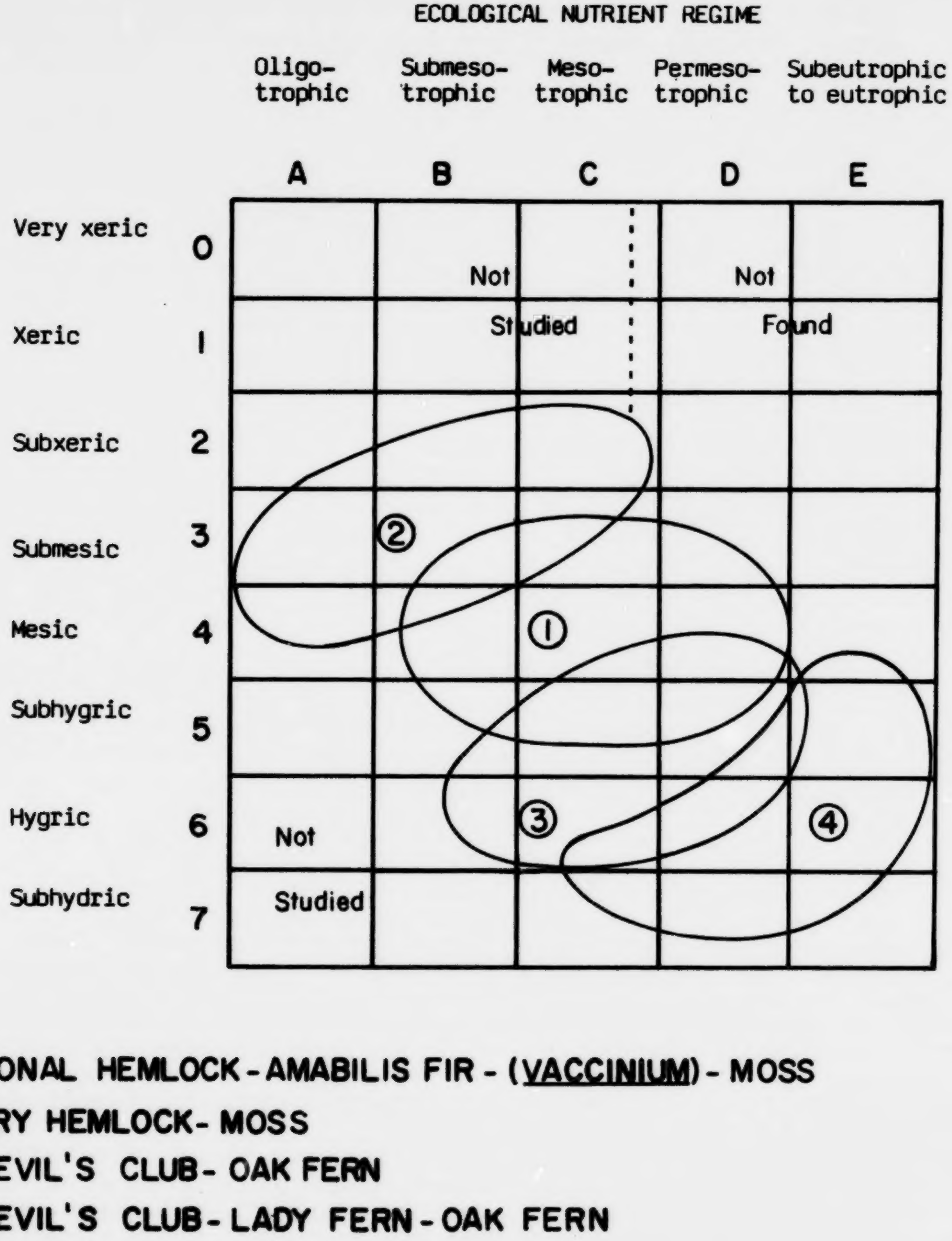
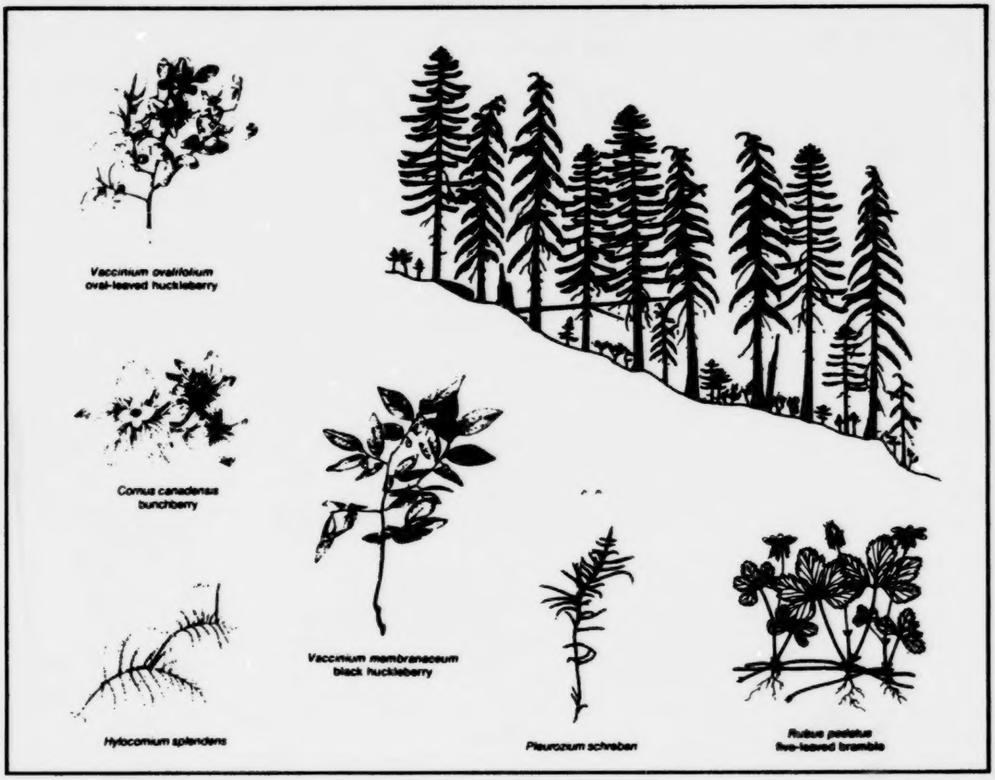

ECOLOGICAL NUTRIENT REGIME
Oligo-trophic
Submeso-trophic
Meso-trophic
Permeso-trophic
Subeutrophic to eutrophic
A
B
C
D
E
Very xeric
0
Xeric
1
Subxeric
2
Submesic
3
Mesic
4
Subhygric
5
Hygric
6
Subhydric
7
Not Studied
Not Found
②
①
③
④
Not Studied
① ZONAL HEMLOCK-AMABILIS FIR-(VACCINIUM)-MOSS
② DRY HEMLOCK-MOSS
③ DEVIL'S CLUB-OAK FERN
④ DEVIL'S CLUB-LADY FERN-OAK FERN

FIGURE 12. Edatopic grid of ecological moisture and nutrient regimes - ICHgla.

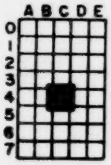
ICHg1a: UPPER NASS BASIN VARIANT: AMABILIS FIR PHASE

/01 ZONAL HEMLOCK - AMABILIS FIR - (VACCINIUM) - MOSS ECOSYSTEM ASSOCIATION (214)[9]


Vaccinium ovalifolium
oval-leaved huckleberry
Cornus canadensis
bunchberry
Vaccinium membranaceum
black huckleberry
Hylocomium splendens
Pleurozium schreberi
Rubus pedatus
five-leaved bramble

ECOLOGICAL MOISTURE REGIME:
mesic

ECOLOGICAL NUTRIENT REGIME:
mesotrophic


A B C D E
0
1
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DISTRIBUTION: widespread throughout the ICHg1a, covering a major portion of the mountain slopes belonging to this phase.

PHYSIOGRAPHIC FEATURES:
Slope position: dominantly mid-slopes, extending to upper and lower slopes; some benches.
Slope range: gentle to steep (10-70%+), rarely level.
Surface shape: variable; generally straight or irregular, rarely convex.
Landforms: chiefly colluvial blankets; some morainal blankets (veneers).

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[9] Number in parentheses is the page number of the appropriate silvicultural prescriptions.

ICHgla/01 ZONAL HEMLOCK - AMABILIS FIR - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: mostly overmature, all-aged stands; trees large for ICHg subzone.

western hemlock	(Tsuga heterophylla)	-usually dominant cover
amabilis fir	(Abies amabilis)	-a significant component of the main canopy

Shrubs: poorly to well-developed layer (10-60%); abundant advance regeneration.

oval-leaved blueberry	(Vaccinium ovalifolium)	
black huckleberry	(Vaccinium membranaceum)	
false azalea	(Menziesia ferruginea)	
[Alaskan blueberry	(Vaccinium alaskaense)]	-absent in some areas

Herbs: poorly to moderately developed layer (5-25%); few species.

five-leaved bramble	(Rubus pedatus)	-consistently present
bunchberry	(Cornus canadensis)	
small twistedstalk	(Streptopus streptopoides)	-characteristic of the ICHgl Ba phase
one-sided wintergreen	(Orthilia secunda)	
single delight	(Moneses uniflora)	

Moss layer: a well-developed carpet.

Hylocomium splendens	-usually dominant
Pleurozium schreberi	
Ptilium crista-castrensis	
Rhytidiopsis robusta	-characteristic of the ICHgl Ba phase
Rhytidiadelphus loreus	

Remarks: This ecosystem association represents the climatic climax ecosystem of the sheltered mid-elevation slopes and valleys belonging to the Amabilis fir Phase of the ICHgl. It is very similar to the climatic climax ecosystem found at high elevations in the Coastal Western Hemlock Zone, Northern drier maritime subzone (CWHf), and reflects strong coastal climatic influences. However, the general scarcity of Alaskan blueberry and Rhytidiadelphus loreus indicate a more continental climate than the CWHf.

Tree growth in this ecosystem association is very good compared to other zonal sites in the ICHg; the trees often reach coastal dimensions. However, most stands are overmature and decadent. Amabilis fir outgrows hemlock on many sites and dominates the advance regeneration. Subalpine fir is occasionally present in the stand but is of small size and seems to die early. Spruce are scattered in some stands and generally grow to a large size.

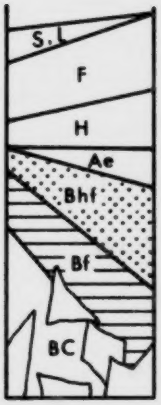
ICHg1a/01 ZONAL HEMLOCK - AMABILIS FIR - (VACCINIUM) - MOSS ECOSYSTEM ASSOCIATION

SOILS: The modal soil profile is characterized by a dark reddish-brown mineral horizon (Bhf), of variable thickness, underlain by a yellowish brown mineral horizon (Bf). Thick organic materials (L, F, and H), often greater than 20 cm in depth, cover the mineral horizons. A pale brown surface mineral horizon (Ae) often separates the B horizons from surface organic layers.

*Soil Classification: dominantly Orthic Humo-Ferric and Ferro-Humic Podzols.

Humus Form Classification: Orthihemimors and Lignohemimors.

Schematic Profile:



Horizon	Description
S(L)	- moss layer with a minor litter component.
F	- slightly decomposed organic layer; dark brown; plentiful fine, medium roots; common fungal mycelia and/or decayed wood.
H	- well-decomposed organic layer; dark brown to black; contains abundant medium, coarse roots.
Ae	- pale brown; loamy sand; structureless; few roots; acidic.
Bhf, Bf	- yellowish brown to reddish brown; loamy sand; plentiful medium roots; high coarse fragment content.
BC	- olive to light yellowish brown; loamy sand to sand; structureless; significant content of angular coarse fragments; few roots.

Orthic Ferro-Humic Podzol
Orthic Humo-Ferric Podzol

*Average pH: mineral horizons - 4.6
organic horizons - 2.9

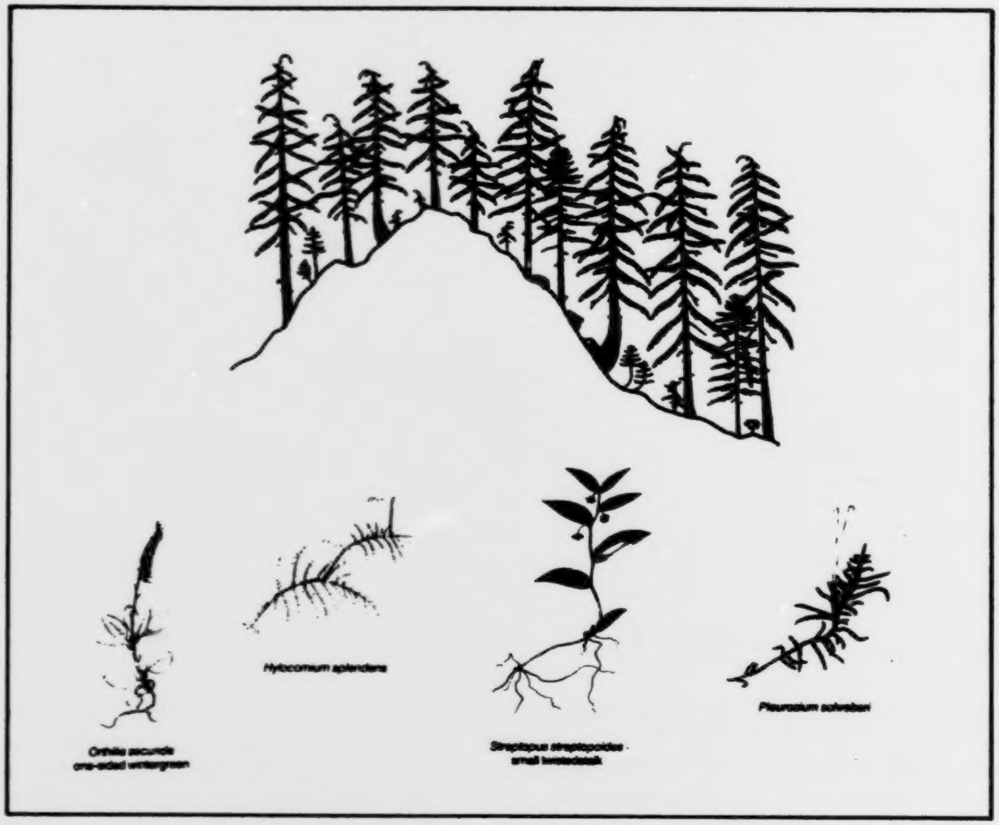
Key Characteristics:
- relatively thick organic layers on the surface.
- soils are generally of coarse loamy texture and have formed primarily on colluvial blankets.
- the coarse fragment content of these soils is generally high, especially in the lower Bf and BC horizons.
- soils are well-drained.
- significant quantities of organic matter have leached down out of the humus and accumulated in surface mineral horizons (Bhf).

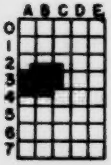
*NOTE: limited sampling of this ecosystem association.

Comments: The well-drained, porous nature of the soils (spaces between coarse fragments) permits deep rooting of vegetation. This ecosystem association appears less sensitive than most to post-logging activities because of the thick humus on most of the soils.

ICHgla: UPPER NASS BASIN VARIANT: AMABILIS FIR PHASE

/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION (215)


Orthilia secunda
one-sided wintergreen
Hylocomium splendens
Streptopus streptopoides -
small twistedstalk
Pleurozium schreberi



ECOLOGICAL MOISTURE REGIME:
(subxeric) - submesic

ECOLOGICAL NUTRIENT REGIME:
submesotrophic

DISTRIBUTION: minor occurrence; found only on extreme sites in the ICHgla, generally in locations exposed to above-average sunlight and rapid drainage.

PHYSIOGRAPHIC FEATURES:

Slope position: generally upper slopes and apices, ridge crests; strongly drained, moisture-shedding positions.

Slope range: level to very steep (0 - 70%+).

Surface shape: generally convex, smooth or irregular; straight when steep.

Landforms: colluvial or morainal veneers over bedrock; some thicker deposits; occasionally coarse-textured glaciofluvial deposits.

ICHgla/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: smaller than on zonal ecosystems.

western hemlock	(*Tsuga heterophylla*)	-dominant cover
[amabilis fir	(*Abies amabilis*)]	-mainly a subcanopy tree, dominates advance regeneration

Shrubs: a poorly developed layer, dominantly coniferous regeneration.

[black huckleberry	(*Vaccinium membranaceum*)]	)-scattered
[false azalea	(*Menziesia ferruginea*)]	) individuals of
[oval-leaved blueberry	(*Vaccinium ovalifolium*)]	) low vigour

Herbs: a poorly developed layer; few species.

[bunchberry	(*Cornus canadensis*)]
[one-sided wintergreen	(*Orthilia secunda*)]
[small twistedstalk	(*Streptopus streptopoides*)]
[five-leaved bramble	(*Rubus pedatus*)]

Moss layer: a well-developed feather moss carpet.

Pleurozium schreberi	-dominant cover
Hylocomium splendens	
Ptilium crista-castrensis	
Rhytidiopsis robusta	

Remarks: The Dry hemlock-moss ecosystem association has a limited distribution because the heavy snowpacks and cool, humid environment in the ICHgla prevent most sites from drying out during the summer months. Sites must have exceptionally shallow or rapidly drained soils or receive above average sunlight for this ecosystem association to develop.

Tree growth is slower than in the Zonal hemlock - amabilis fir - (*Vaccinium*) moss e.a. (ICHgla/01), especially for amabilis fir. Nonetheless, amabilis fir dominates advance regeneration and is abundant in sub-canopy layers. Spruce and subalpine fir are rare.

Other features that distinguish this ecosystem association from the ICHgla/01 are the lack of a shrub layer and predominance of the moss *Pleurozium schreberi*.

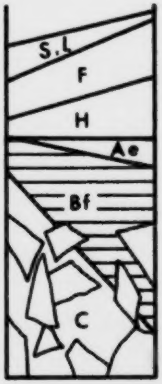
ICHgla/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soils of this dry ecosystem association generally show less profile development than zonal soils. Yellowish red surface B horizons may reach 20 cm in depth, or coloured horizons may be totally lacking, as in the case of recent colluvial deposits that may show grayish colours up to the mineral surface. Thin, acidic surface horizons (Ae) generally do not show pale brown colours indicative of intense leaching under high rainfall, but still show reddish colouration. Organic materials may often accumulate to depths greater than 12 cm, with both fungal F and well-decomposed H horizons common.

Soil Classification: Orthic Humo-Ferric Podzols; Orthic Regosols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; dark brown; plentiful fine, medium roots; common white, yellow mycelia.
H	- well-decomposed; black; abundant medium, coarse roots; fine blocky structure.
Ae	- pale brown; loamy sands; few roots; very acidic.
Bf	- yellowish red to strong brown; loamy sands to sandy loam; plentiful medium roots; high coarse fragment content.
C	- dark gray to olive gray; sandy; few fine roots; coarse fragment volume greater than 50%.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.3
organic horizons - 3.2

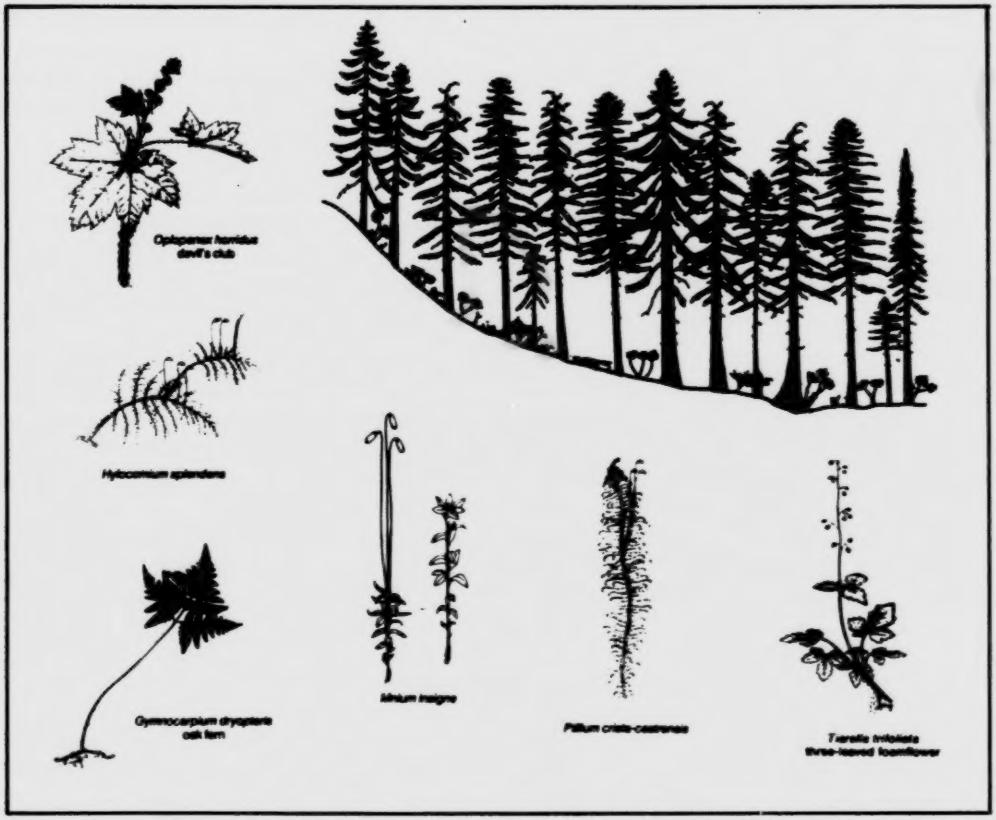
Key Characteristics:

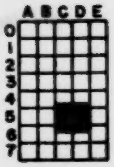
- well-drained, coarse textured, acidic soils forming in upper elevations and subject to erosion.
- some soils may show only weak structure and colour development of B horizons.
- effective rooting depth less than 70 cm.

Comments: High coarse fragment content, coarse mineral textures, freely drained organic layers, and upper slope positions may all contribute to significant moisture deficiencies during the growing season.

ICHg1a: UPPER NASS BASIN VARIANT: AMABILIS FIR PHASE

/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION (216)


Oplopanax horridus
devil's club
Hylocomium splendens
Mnium insigne
Ptilium crista-castrensis
Gymnocarpium dryopteris
oak fern
Tiarella trifoliata
three-leaved foamflower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ECOLOGICAL MOISTURE REGIME:
subhygric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic

DISTRIBUTION: found throughout the ICHg1a, but not covering as much area as the zonal ecosystem association.

PHYSIOGRAPHIC FEATURES:
Slope position: middle to lower slopes, minor snowmelt pockets and drainages, (valley floors); positions receiving some seepage.
Slope range: level to steep, but usually gently sloping.
Surface shape: irregular, concave to straight, rarely convex.
Landforms: morainal and colluvial blankets, frequently washed; fluvial deposits.

ICHgla/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: all species growing well.

western hemlock	(*Tsuga heterophylla*)	)-either one may
amabilis fir	(*Abies amabilis*)]	) dominate cover
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-scattered, but excellent growth

Shrubs: moderately- to well-developed layer; advance regeneration not abundant.

devil's club	(*Oplopanax horridus*)	-characteristic but not always dominant
oval-leaved blueberry	(*Vaccinium ovalifolium*)	
black gooseberry	(*Ribes lacustre*)	-characteristic but inconspicuous

Herbs: usually fairly well-developed layer, moderate species diversity.

oak fern	(*Gymnocarpium dryopteris*)	-characteristic dominant
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	)-consistently present, good indicators
twistedstalks	(*Streptopus streptopoides*, *S. roseus*, *S. amplexifolius*)	)-consistently pre-) sent, good vigour,
bunchberry	(*Cornus canadensis*)	) not good
five-leaved bramble	(*Rubus pedatus*)	) indicators
[spiny wood fern	(*Dryopteris assimilis*)]	)-small pockets com-
[lady fern	(*Athyrium filix-femina*)]	) mon, moderate vigour

Moss layer: usually moderately developed carpet of feather mosses, leafy (*Mnium*) mosses common in depressions.

Hylocomium splendens
Ptilium crista-castrensis
Pleurozium schreberi
Mnium spp.
[*Brachythecium* spp.]
[*Rhytidiadelphus loreus*]
[*Barbilophozia* spp.]

Remarks: This is a productive ecosystem association for hemlock, amabilis fir, and spruce. Although spruce is not a major species in climax stands, it is normally the largest tree in the stand. Subalpine fir is occasionally present, particularly in areas of cold air drainage, but does not reach the dimensions of the other tree species.

Devil's club is common and conspicuous but rarely totally dominates the shrub layer. Instead it usually occurs in mixture with *Vaccinium* spp. and false azalea. Depressional microsites within the Devil's club - oak fern e.a. may often be wetter and contain indicator species from the Devil's club - lady fern - oak fern e.a. (ICHgla/04).

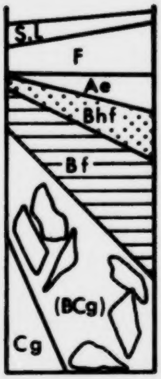
ICHg1a/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: Soils within this ecosystem association have developed in receiving positions where plentiful moisture is available for most of the growing season. Yellowish red to brown B horizons are common, with some profiles also showing darker reddish brown surface horizons indicative of organic matter accumulation (Bhf). Profile textures are generally loamy throughout, with high coarse fragment volumes (greater than 40%). Mottles (bright, blotchy patches) may occur in lower mineral horizons, suggesting temporary saturation with water. Surface organic layers are relatively thin, ranging from 4 to 6 cm in depth.

Soil Classification: Orthic Humo-Ferric Podzols and Gleyed Humo-Ferric Podzols.

Humus Form Classification: dominantly Orthihemimors with minor Orthimormoders.

Schematic Profile:



Horizon	Description
F	- moderately decomposed organic horizon; dark brown; plentiful fine, medium roots; common white, yellow mycelia and/or insects.
Ae	- pale brown; loamy sand; few coarse roots; acidic.
Bhf	- dark reddish brown; sandy loam; plentiful medium, coarse roots.
Bf	- yellowish brown to yellowish red; loamy sand; few to plentiful fine, medium roots; structureless.
BC, (BCg)	- yellowish to olive brown; loamy sand to loam; few fine roots; may contain significant volume of coarse fragments; may contain mottling and/or seepage.

Orthic Humo-Ferric Podzol
(Gleyed Humo-Ferric Podzol)

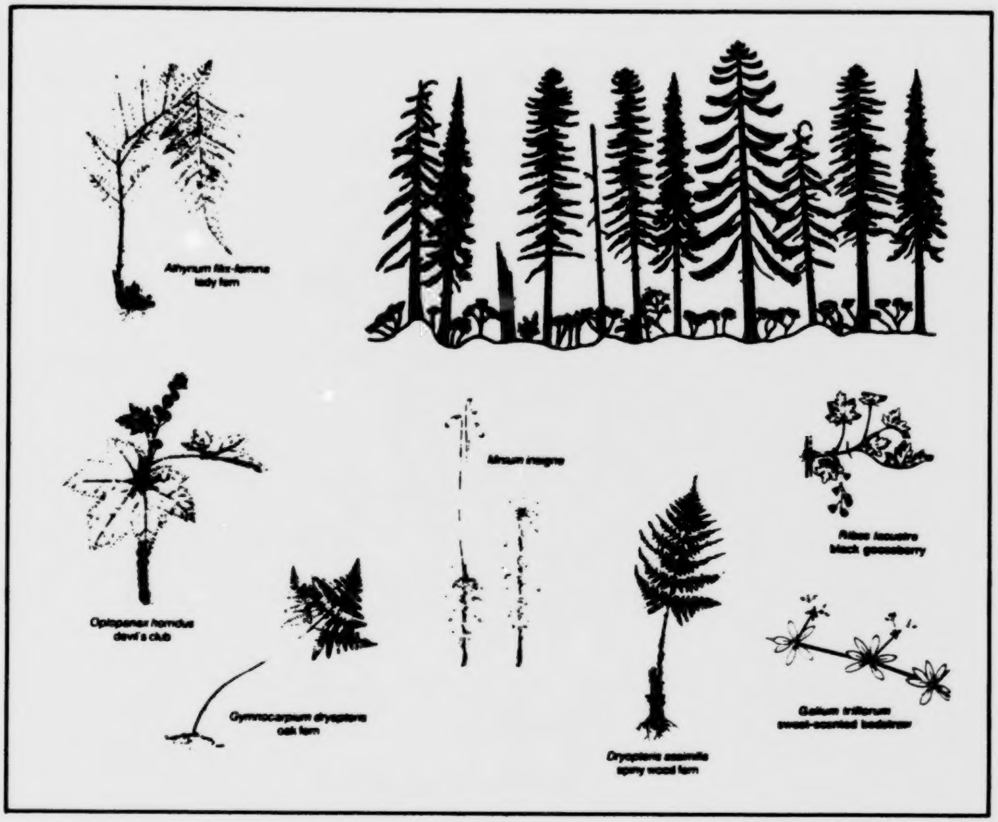
Average pH: mineral horizons - 4.5
organic horizons - 4.3

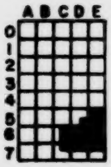
Key Characteristics:

- these soils are often found at lower slope positions on morainal, fluvial and colluvial deposits.
- the coarse fragment content is high on colluvial blankets.
- mottling may occur in lower soil horizons (BCg, Cg).
- development of leached Ae horizon at the mineral surface.
- relatively thin humus forms that are usually decomposing rapidly.

ICHg1a: UPPER NASS BASIN VARIANT: AMABILIS FIR PHASE

/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION (217)


Athyrium filix-femina
lady fern
Oplopanax horridus
devil's club
Mnium insigne
Ribes lacustre
black gooseberry
Gymnocarpium dryopteris
oak fern
Dryopteris assimilis
spiny wood fern
Galium triflorum
sweet-scented bedstraw



ECOLOGICAL MOISTURE REGIME:
(subhygric+) - hygric

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - eutrophic

DISTRIBUTION: small pockets of this ecosystem association are found on mountain sides throughout the ICHg1a. Larger stands are uncommon and restricted to valley floors.

PHYSIOGRAPHIC FEATURES:
Slope position: valley floor, lower and toe slopes, gulleys and drainage channels; sites receiving abundant seepage.
Slope range: level to moderately sloping, usually gentle (0 - 25%).
Surface shape: concave to straight.
Landforms: fluvial; colluvial or morainal deposits, usually washed.

ICHgla/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: large, generally widely spaced, composition variable; little advance regeneration.

amabilis fir	(*Abies amabilis*)	
subalpine fir	(*Abies lasiocarpa*)	-very common esp. at higher elevations
western hemlock	(*Tsuga heterophylla*)	-generally in subcanopy layers
hybrid spruce	(*Picea glauca* x *sitchensis* x ? *engelmannii*)	-largest tree

Shrubs: generally a well-developed, tall layer, especially in stand openings.

devil's club	(*Oplopanax horridus*)	-generally dominates shrub layer
black gooseberry	(*Ribes lacustre*)	-consistently present but inconspicuous
[blueberry/huckleberry	(*Vaccinium* spp.)]	)-confined to decaying wood and mounds
[false azalea	(*Menziesia ferruginea*)]	)
[currants	(*Ribes* spp.)]	)
[salmonberry	(*Rubus spectabilis*)]	)
[red elderberry	(*Sambucus racemosa*)]	)-good indicators when present
[thimbleberry	(*Rubus parviflorus*)]	)

Herbs: a well-developed layer; fairly diverse species composition.

lady fern	(*Athyrium filix-femina*)	-characteristic dominant
oak fern	(*Gymnocarpium dryopteris*)	-usually dominant under devil's club
spiny wood fern	(*Dryopteris assimilis*)	
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
twistedstalks	(*Streptopus streptopoides*, *S. roseus*, *S. amplexifolius*)	
[sweet-scented bedstraw	(*Galium triflorum*)]	)-excellent indicators when present
[enchanter's nightshade	(*Circaea alpina*)]	)
[common horsetail	(*Equisetum arvense*)]	)
[violets	(*Viola* spp.)]	)

Moss layer: dominated by leafy mosses and liverworts; feather mosses confined to decaying wood and elevated mounds.

Mnium spp.	-dominant cover
Brachythecium spp.	
[*Barbilophozia* spp.]	
[*Rhytidiadelphus loreus*]	

Remarks: This is the most productive ecosystem association in the ICHgla. Small patches of it develop wherever a drainage channel occurs; however, extensive stands are rare. All of the tree species occuring in the Amabilis fir phase grow well in this unit, although hemlock growth may be restricted on all but the best drained microsites. Subalpine fir is very common in these ecosystems because many of them occur in cold air drainages. Advance regeneration is sporadic, but spruce reproduction on decaying wood is more common here than in the other ecosystem associations.

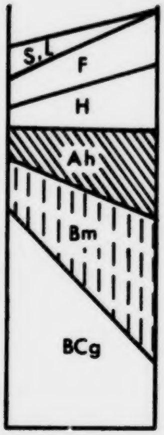
ICHgla/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: Soil profiles of this association have developed on slope positions that receive abundant moisture, leaving soils wet for a major portion of the growing season. Seepage waters and/or high water tables usually result in the occurrence of mottles, often within 30 cm of the mineral surface. Brownish (Bm) to reddish-brown (Bhf, Bf) mineral horizons occur near the surface of soil profiles. These horizons may be overlain by a very dark brown to black mineral horizon (Ah), often greater than 10 cm thick. Surface organic materials range 7-18 cm in depth, and often contain a well-decomposed black H horizon as the dominant layer.

Soil Classification: Orthic Gleysols and Gleyed subgroups of Brunisols, Regosols, and Podzols.

Humus Form Classification: Amphimormoders; Orthihemihumimors.

Schematic Profile:



Horizon	Description
F	- intermediate decomposition; dark brown organic layer; active fungal and zoogenous decomposition; loose structure common.
H	- black to dark brown; well-decomposed organic horizon either well-aerated (H), or wet and saturated (Oh).
Ah	- dark brown to black mineral horizon; silt loam to silty clay loam; granular structure; abundant medium, coarse roots.
Bm	- brown (Bm) to strong brown (Bf); loam to clay; plentiful fine, medium roots.
BCg	- dark grayish brown; loam to clay; seepage and/or mottling present; water table generally within 60 cm; massive.

Gleyed Dystric Brunisol

Key Characteristics:

- surface organic horizons are usually wet and moderately thick.
- subsurface mineral horizons may show evidence of being water-worked (sorted, coarser textured till).
- soil horizons are wet, often throughout the entire profile.
- drainage is usually restricted by high water tables which may be perched over compacted layers.
- lower horizons may have a hard massive structure that roots cannot penetrate.

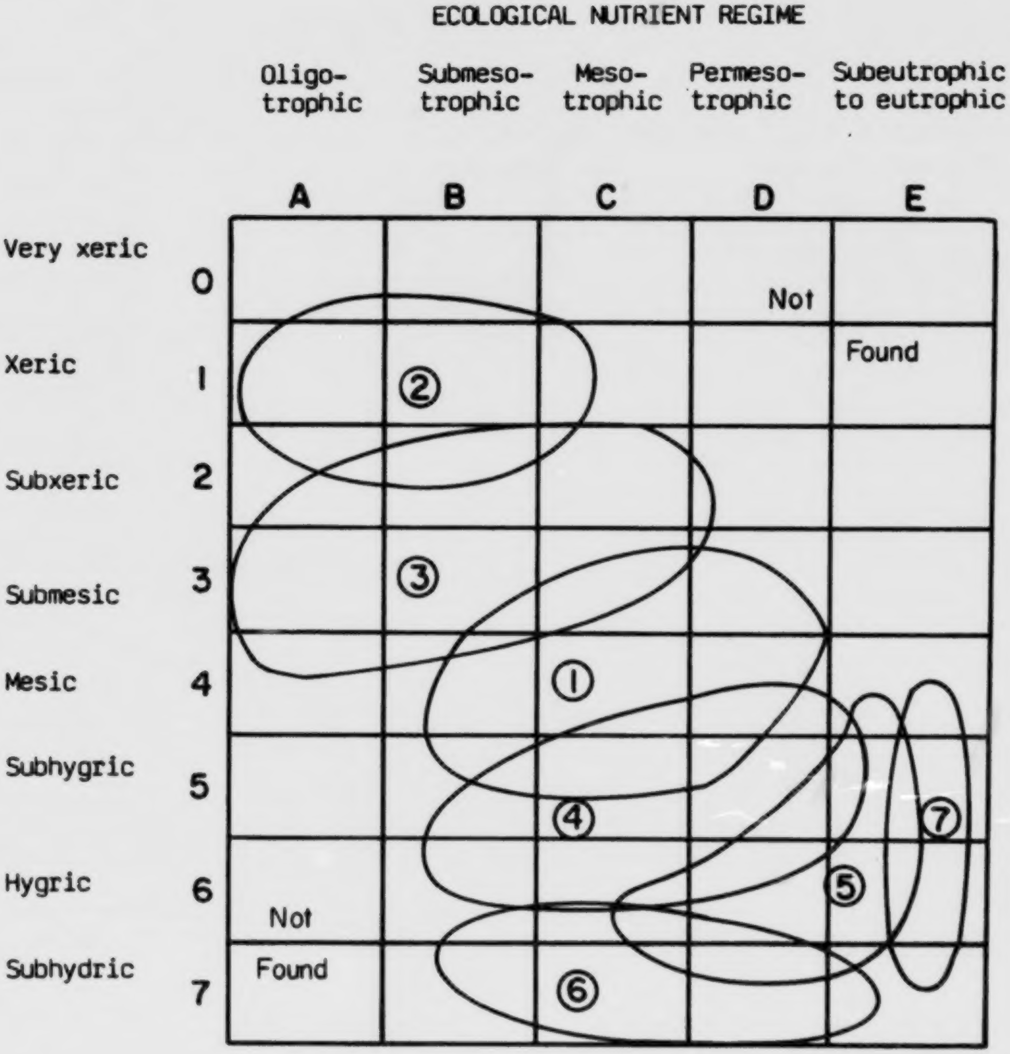
Comments: Seepage waters are commonly found within 40 cm of the soil surface and may contain abundant available nutrients for vegetation. Depth of rooting is often restricted by excessive moisture, which in turn may lead to compacted soils lacking pores for free air movement. Surface organic and mineral horizons have a high capacity to hold water.

7.3 Classification of Ecosystem Units of the ICHg2: Lower Nass Basin Variant

/01 Zonal hemlock - (cedar) - moss ecosystem association
/02 Pine - lichen ecosystem association
/03 Dry hemlock - moss ecosystem association
/04 Devil's club - oak fern - feather moss ecosystem association
/05 Devil's club - fern - leafy moss ecosystem association
/06 Horsetail swamp ecosystem association

Seral ecosystem association:
/07 Floodplain cottonwood seral ecosystem association

Seral variations

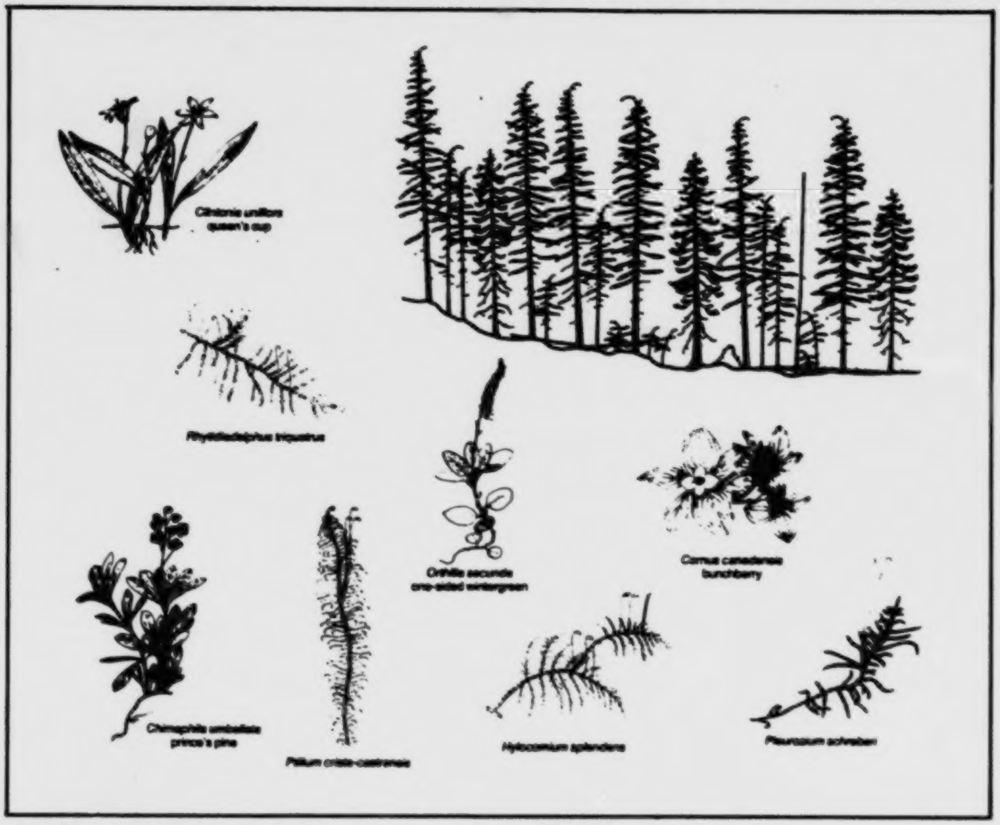

ECOLOGICAL NUTRIENT REGIME
Oligo-trophic
Submeso-trophic
Meso-trophic
Permeso-trophic
Subeutrophic to eutrophic
A
B
C
D
E
Very xeric
0
Xeric
1
Subxeric
2
Submesic
3
Mesic
4
Subhygric
5
Hygric
6
Subhydric
7
Not
Found
Not
Found
②
③
①
④
⑤
⑥
⑦

① ZONAL HEMLOCK - (CEDAR) - MOSS
② PINE - LICHEN
③ DRY HEMLOCK - MOSS
④ DEVIL'S CLUB - OAK FERN - FEATHER MOSS
⑤ DEVIL'S CLUB - FERN - LEAFY MOSS
⑥ HORSETAIL SWAMP
⑦ FLOODPLAIN COTTONWOOD

FIGURE 13. Edatopic grid of ecological moisture and nutrient regimes - ICHg2.

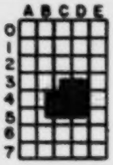
ICHg2: LOWER NASS BASIN VARIANT

/01 ZONAL HEMLOCK - (CEDAR) - MOSS ECOSYSTEM ASSOCIATION (219)[10]


Clintonia uniflora
queen's cup
Rhytidiadelphus triquetrus
Orthilia secunda
one-sided wintergreen
Cornus canadensis
bunchberry
Chimaphila umbellata
prince's pine
Ptilium crista-castrensis
Hylocomium splendens
Pleurozium schreberi

ECOLOGICAL MOISTURE REGIME:
mesic - (subhygric)

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic


A B C D E
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DISTRIBUTION: common and widely distributed throughout the ICHg2, covering a significant portion of the landscape.

PHYSIOGRAPHIC FEATURES:
Slope position: upper, middle, and lower slopes; occasionally on benches, terraces, or valley floor.
Slope range: gentle to moderately sloping, rarely flat or very steep.
Surface shape: straight, irregular or smooth; occasionally slightly concave or convex.
Landforms: morainal and colluvial blankets (veneers); rarely lacustrine or fluvial deposits.

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[10] Number in parentheses is the page number of appropriate silvicultural prescriptions.

ICHg2/01 ZONAL HEMLOCK - (CEDAR) - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: larger, wider spacing than in Dry hemlock - moss e.a.

western hemlock	(*Tsuga heterophylla*)	-usually dominant cover
western redcedar	(*Thuja plicata*)	-occasionally dominant cover
[lodgepole pine	(*Pinus contorta*)]	-seral remnants in or above main canopy
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-tallest tree when present
[subalpine fir	(*Abies lasiocarpa*)]	-usually poor vigour

Shrubs: very poorly developed layer, frequently absent; primarily coniferous regeneration.

black huckleberry	(*Vaccinium membranaceum*)	
false azalea	(*Menziesia ferruginea*)	-scattered individuals, low vigour
falsebox	(*Paxistima myrsinites*)	

Herbs: poorly to moderately well-developed layer.

prince's pine	(*Chimaphila umbellata*)	)-generally good
bunchberry	(*Cornus canadensis*)	) vigour
one-sided wintergreen	(*Orthilia secunda*)	)
queen's cup	(*Clintonia uniflora*)	)
rattlesnake plantain	(*Goodyera oblongifolia*)	)
[wild sarsaparilla	(*Aralia nudicaulis*)]	-important in some stands

Moss layer: well-developed moss cover except where there is a heavy cover of cedar.

Hylocomium splendens
Ptilium crista-castrensis
Rhytidiadelphus triquetrus
Pleurozium schreberi

Remarks: Cedar is a component of the main tree canopy and dominates the cover in a few stands belonging to the Zonal hemlock - (cedar) - moss ecosystem association. Its growth, however, is still generally slower than that of hemlock. Pine seems to have faster initial growth than spruce, but spruce sustains its rate of growth and is the largest tree in mature stands.

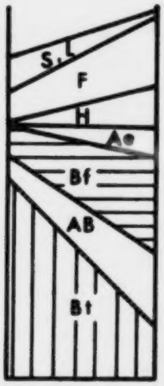
ICHg2/01 ZONAL HEMLOCK - (CEDAR) - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles have characteristic fine textured subsurface horizons (Bt) showing evidence of downward clay movement in the form of clay skins on ped surfaces and/or in pores. Coarse textured soils are uncommon on these mid-slope morainal deposits. Clayey Bt horizons are overlain by loamy, light brown (Bm) or yellowish-brown (Bf) mineral horizons. Some temporary seepage and/or mottles may be present in lower mineral horizons. Surface organic horizons range in depth from 5 to 15 cm and are in a moderate stage of decomposition.

Soil Classification: Brunisolic and Podzolic Gray Luvisols (Kispiox, Suskwa Valleys) with a minor occurrence of Gleyed subgroups of Luvisols, Brunisols, and Podzols (Nass Valley).

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; medium brown; plentiful medium, coarse roots; matted.
H	- well-decomposed; dark brown; some incorporation of mineral grains.
Bf	- yellowish-brown (Bf) to brown (Bm); sandy loam to silt loam; plentiful medium roots.
AB	- olive brown to brownish-gray; few fine, medium roots; angular to massive structure; may contain mottles.
Bt	- dark grayish brown; loam to clay loam; angular to massive; clay skins may occur on coarse fragments and/or in pores; few roots.

Podzolic Gray Luvisol

Average pH: mineral horizons - 5.1
organic horizons - 3.8

Key Characteristics:
- fine textured subsurface horizons are common.
- subsurface horizons may become compact and impenetrable to roots, particularly when dry or wet.
- effective rooting generally shallow with majority of roots in the upper 25 cm of mineral soil.
- mottling may occur in lower horizons (AB, Bt).

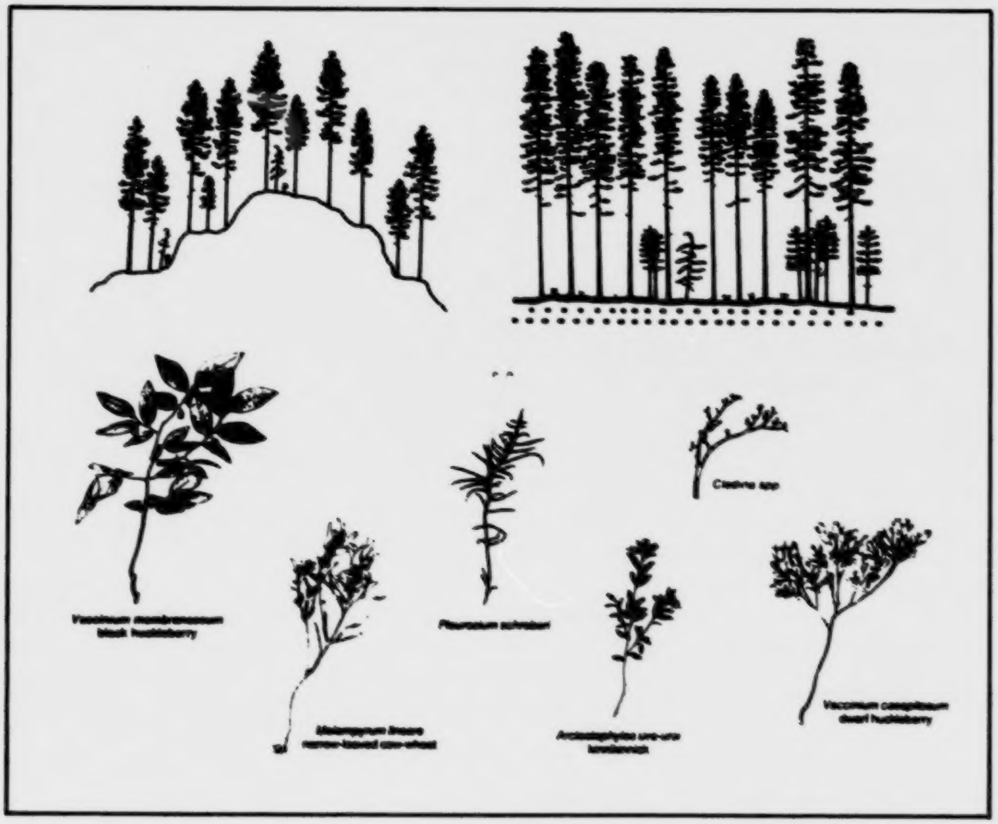
Comments: Because of the relatively fine soil textures and lower to middle slope positions, nutrient cations should be readily available to vegetation, particularly in the surface mineral horizons.

ICHg2: LOWER NASS BASIN VARIANT

/02 PINE - LICHEN ECOSYSTEM ASSOCIATION (220)

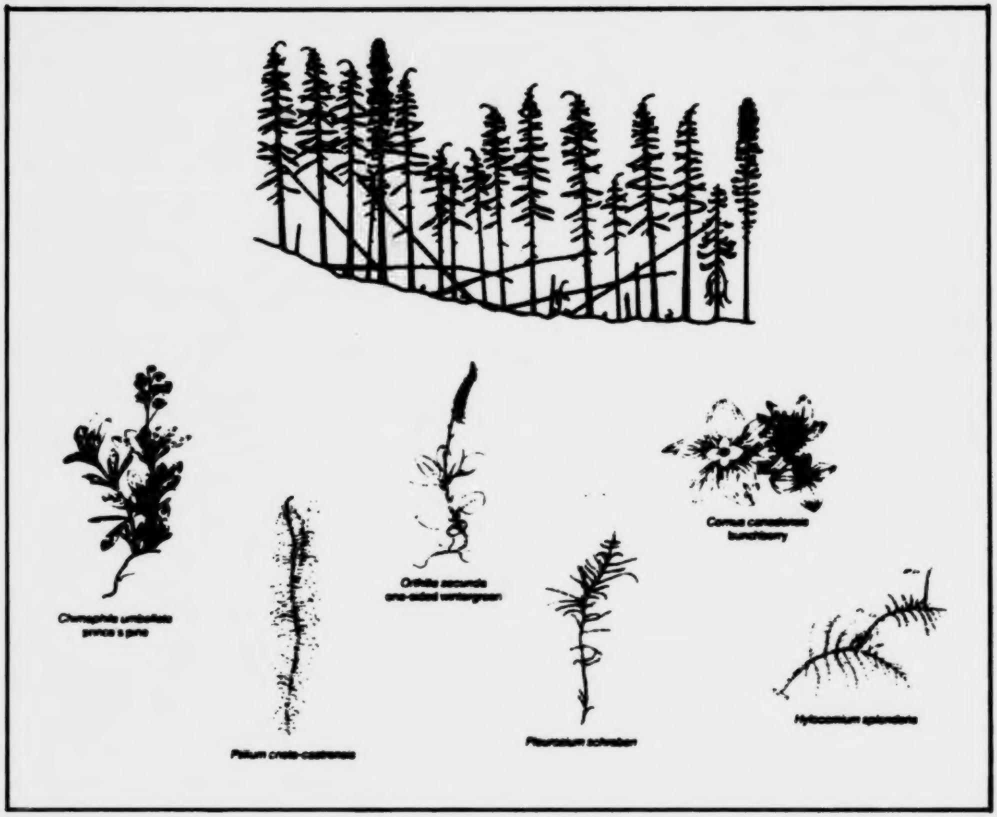
Remarks: This ecosystem association has a limited distribution in the ICHg2 variant, and is unimportant for forest management. It includes ecosystems on the very driest and nutrient-poor rock outcrops, ridges, and outwash terraces where lodgepole pine is maintained as a result of repeated fire. Most dry pine stands in the ICHg2 do not belong to this seral ecosystem association, but merely represent seral variations of the Dry hemlock - moss ecosystem association (ICHg2/03).

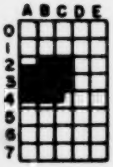
For a complete description and management interpretations of the Pine - lichen e.a. refer to the corresponding ecosystem unit in the g3 (Hazelton) variant (ICHg3/02).


Vaccinium membranaceum
black huckleberry
Pleurozium schreberi
Cladina spp.
Melampyrum lineare
narrow-leaved cow-wheat
Arctostaphylos uva-ursi
kinnikinnick
Vaccinium caespitosum
dwarf huckleberry

ICHg2: LOWER NASS BASIN VARIANT

/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION (221)


Chimaphila umbellata
prince's pine
Ptilium crista-castrensis
Orthilia secunda
one-sided wintergreen
Pleurozium schreberi
Cornus canadensis
bunchberry
Hylocomium splendens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ECOLOGICAL MOISTURE REGIME:
(subxeric) - submesic

ECOLOGICAL NUTRIENT REGIME:
submesotrophic - (mesotrophic)

DISTRIBUTION: very common and widely distributed throughout the ICHg2; covering a major portion of the landscape.

PHYSIOGRAPHIC FEATURES:

Slope position: upper slopes and ridge crests, extending to mid-slope, benches, terraces; often moisture-shedding positions.

Slope range: level to very steep (0 - 75%+).

Surface shape: straight or convex, flat; very rarely concave.

Landforms: morainal and colluvial veneers and blankets; coarse textured glaciofluvial (kame) deposits.

ICHg2/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: typically small, dense stocking.

western hemlock	(*Tsuga heterophylla*)	-dominant cover
lodgepole pine	(*Pinus contorta*)	-scattered in and above main canopy
[subalpine fir	(*Abies lasiocarpa*)]	)-poor growth, generally restricted to subcanopy layers
[western redcedar	(*Thuja plicata*)]	)
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-scattered, poor vigour but still taller than hemlock

Shrubs: a very poorly developed layer, frequently absent; little advance regeneration.

[black huckleberry	(*Vaccinium membranaceum*)]	-scattered, low vigour
[false azalea	(*Menziesia ferruginea*)]	
[Saskatoon	(*Amelanchier alnifolia*)]	-seral remnants, dying out
[Douglas maple	(*Acer glabrum*)]	

Herbs: a very poorly developed layer, occasionally absent; may include one or more of:

[bunchberry	(*Cornus canadensis*)]	)-scattered individuals or small patches of low vigour
[prince's pine	(*Chimaphila umbellata*)]	)
[one-sided wintergreen	(*Orthilia secunda*)]	)
[green wintergreen	(*Pyrola chlorantha*)]	)
[twinflower	(*Linnaea borealis*)]	)
[rattlesnake plantain	(*Goodyera oblongifolia*)]	)
[round-leaved rein-orchid	(*Platanthera orbiculata*)]	)

Moss layer: generally a well-developed, solid carpet of feather mosses.

Hylocomium splendens
Pleurozium schreberi
Ptilium crista-castrensis
Rhytidiadelphus triquetrus

Remarks: Dry hemlock - moss ecosystem association represents submesic-to-mesic and drier ecosystems with a relatively poor nutrient status. The dominant visual features of this e.a. are the rather poor tree growth in stands that are often dense, and a very bare understory containing little more than a carpet of feather moss. Hemlock dominates climax stands. Pine is its most frequent associate and tends to be the dominant cover in seral stands belonging to this e.a. Pine also appears to be the fastest growing tree in this unit. Small, suppressed cedar are quite common below the main canopy but they rarely reach a co-dominant position in the stand. Spruce are infrequent and have low vigour.

It is sometimes difficult to differentiate between the Dry (ICHg2/03) and the Zonal (ICHg2/01) hemlock - moss e.a.'s except by comparing relative tree productivity and the relative diversity and vigour of understory species. These are poorer in the ICHg2/03. Furthermore, in the Dry hemlock - moss e.a., *Pleurozium schreberi* tends to be a dominant moss and herbs such as queen's cup and wild sarsaparilla are generally absent or have very low vigour.

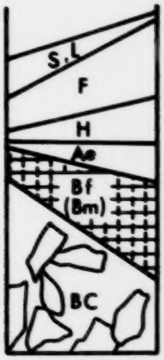
ICHg2/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soils of this dry ecosystem association generally show moderate profile development. Soil textures range from loams and sandy loams on morainal and colluvial blankets, to coarser sands on glaciofluvial landforms. Reddish-brown (Bf) and/or brown (Bm) mineral horizons dominate the upper 20 cm of the mineral profile. These surface horizons have slightly finer textures than the well-drained sandy subsurface horizons (BC and C), which usually have a high gravel content. Organic materials are variable in depth between 5 and 16 cm, with fungal mycelia abundant.

Soil Classification: Orthic Humo-Ferric Podzols and minor Eluviated Dystric Brunisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed organic horizon; brown to dark brown; abundant medium, fine roots; matted structure.
H	- well-decomposed organic horizon; black; abundant medium, coarse roots.
Ae	- pale brown; loamy; leached; few coarse roots.
Bf (Bm)	- reddish brown to brown; loam to sandy loam; granular structure; plentiful fine, medium roots.
BC	- yellowish brown to brown; coarse loamy to sandy; few to plentiful fine roots; may have high coarse fragment volume.

Orthic Humo-Ferric Podzol
(Eluviated Dystric Brunisol)

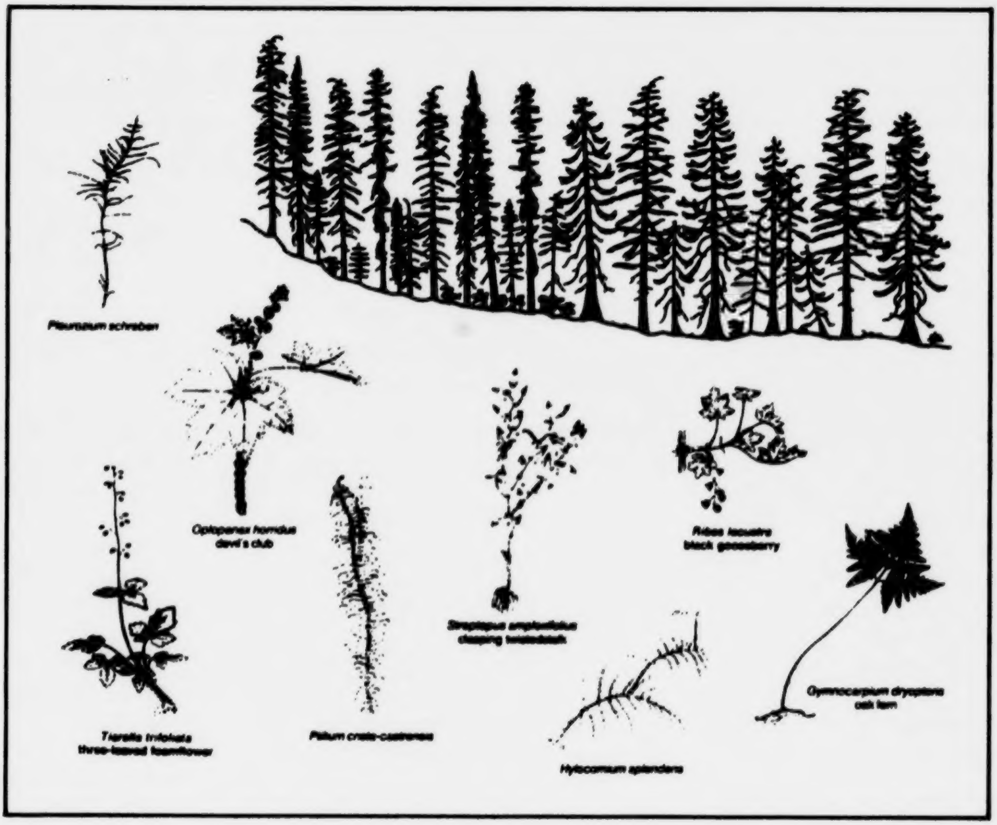
Average pH: mineral horizons - 4.7
organic horizons - 4.2

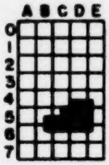
Key Characteristics:
- increasing occurrence of fragmental bedrock in upper elevations.
- some glacially compacted subsurface horizons at depth in excess of 50 cm.
- lack of seepage and/or mottling.
- commonly occur on apex or upper slope positions.

Comments: Because of upper slope position, relatively coarse soil textures, and/or high coarse fragment content, soils of this association have already had much of the surface mineral fines washed away. As a result, nutrients and moisture may be lacking for certain periods during the growing season.

ICHg2: LOWER NASS BASIN VARIANT

/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION (222)


Pleurozium schreberi
Oplopanax horridus
devil's club
Streptopus amplexifolius
clasping twistedstalk
Ribes lacustre
black gooseberry
Tiarella trifoliata
three-leaved foamflower
Ptilium crista-castrensis
Hylocomium splendens
Gymnocarpium dryopteris
oak fern


A B C D E
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ECOLOGICAL MOISTURE REGIME:
subhygric

ECOLOGICAL NUTRIENT REGIME:
(mesotrophic) - permesotrophic

DISTRIBUTION: found throughout the ICHg2, but less common than zonal ecosystems and generally less extensive.

PHYSIOGRAPHIC FEATURES:

Slope position: lower (middle) slopes, valley floors, minor drainages; sites receiving some seepage.

Slope range: level to moderately steep, mainly gently sloping.

Surface shape: straight to concave, occasionally flat.

Landforms: morainal blankets; colluvial over morainal deposits, occasionally washed; some fluvial deposits.

ICHg2/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees:

western hemlock	(*Tsuga heterophylla*)
western redcedar	(*Thuja plicata*)
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]
[subalpine fir	(*Abies lasiocarpa*)]

Shrubs: usually a moderately well-developed layer; moderate species diversity.

devil's club	(*Oplopanax horridus*)	-characteristic constant, sparse in most stands
[black gooseberry	(*Ribes lacustre*)]	
[thimbleberry	(*Rubus parviflorus*)]	
[black huckleberry	(*Vaccinium membranaceum*)]	
[false azalea	(*Menziesia ferruginea*)]	

Herbs: usually a moderately well-developed layer; moderate species diversity.

oak fern	(*Gymnocarpium dryopteris*)	-characteristic dominant herb
queen's cup	(*Clintonia uniflora*)	)
bunchberry	(*Cornus canadensis*)	)-abundant, good
one-sided wintergreen	(*Orthilia secunda*)	) vigour, but not
green wintergreen	(*Pyrola chlorantha*)	) good indicator
twinflower	(*Linnaea borealis*)	) species
foamflowers	(*Tiarella trifoliata*,	)-minor occurrence,
	T. unifoliata)	) good indicator
clasping twistedstalk	(*Streptopus amplexifolius*)	) species
[wild sarsaparilla	(*Aralia nudicaulis*)]	-good indicator when present, important in some stands

Moss layer: a well-developed carpet of feather moss.

Hylocomium splendens	
Pleurozium schreberi	
Ptilium crista-castrensis	
[*Mnium* spp.]	-minor, only in wettest depressions

Remarks: All of the commercial tree species in the ICHg2 grow well in this ecosystem unit. Spruce is usually the largest tree present but is rarely a major component of any stand. Lodgepole pine is absent from most mature stands, but shows excellent early growth in young stands belonging to this unit.

Devil's club and oak fern, the two primary indicator plant species, are often poorly developed in eastern sections of the ICHg2. In these areas feather mosses seem to "invade" the site, building up a thick mossy humus and excluding the herbs and shrubs typically found on subhygric sites. Where this takes place it may be difficult to distinguish subhygric ecosystems from Zonal hemlock-moss ecosystems. The entire forest understory, from ridgetop to creek draw, consists of one rolling moss carpet. Soil and landform characteristics and relative tree growth must then be used to differentiate ecosystem associations.

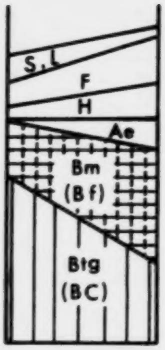
ICHg2/04 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles are usually very moist to wet, often containing mottles and/or seepage close to the soil surface. However, there are some soils that are quite well-drained, without mottling within the soil profile. All soils are relatively deep and have formed primarily on morainal and colluvial blankets. In the wetter soils, textures range from loams to clay loams with well-drained brown surface horizons (Bm) overlying imperfectly to poorly drained grayish-brown (Bt) horizons. Soils that are well-drained throughout the profile have sandy loam, strong brown (Bf) to dark reddish-brown (Bhf) surface horizons.

Soil Classification: (Gleyed) Brunisolic Gray Luvisols and Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors and Orthimormoders.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; brown to dark brown; plentiful fine, medium roots; common fungal mycelia and/or insects.
H	- well-decomposed; dark brown; abundant medium, coarse roots; significant moisture retention.
Bm (Bf)	- strong brown (Bf, Bm) to dark-reddish brown (Bhf); sandy loam to loam; plentiful fine, medium, coarse roots.
Btg (BC)	- yellowish brown (BC) to grayish-brown (Btg); loamy sand to clay loam; few roots; mottles may occur; clay skins may be common on ped faces and/or in pores.

Gleyed Brunisolic Gray Luvisol
(Orthic Humo-Ferric Podzol)

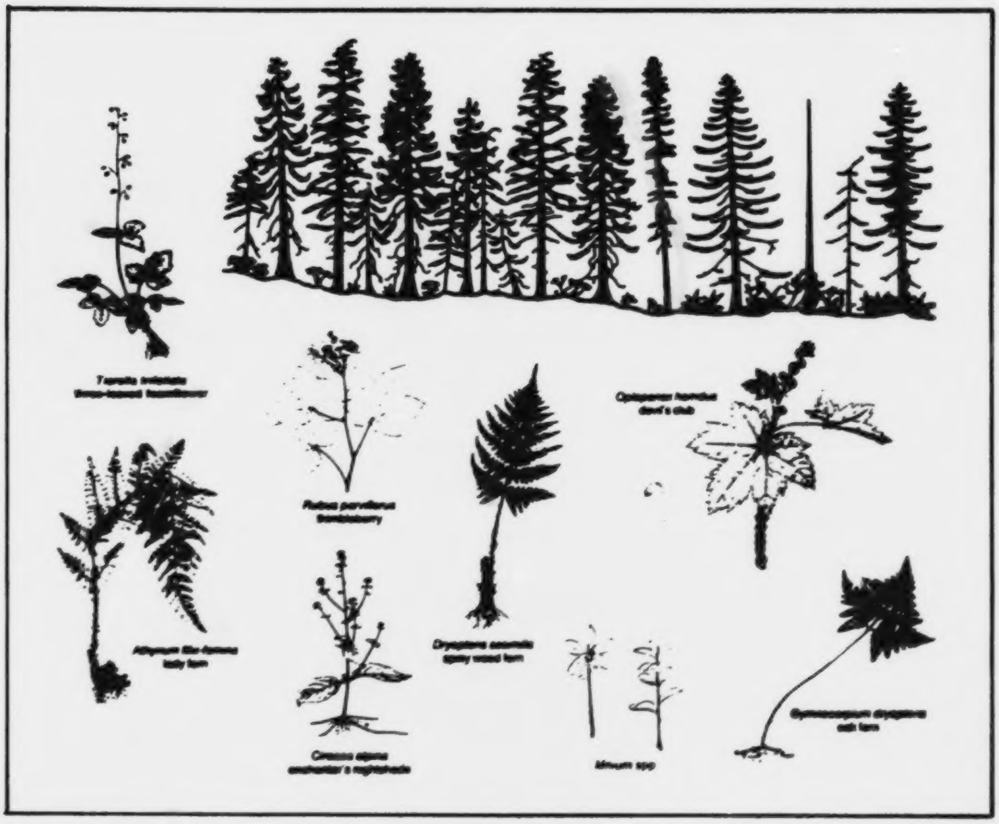
Average pH: mineral horizons - 4.9 (limited data)
organic horizons - 3.7 (limited data)

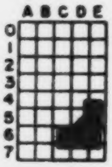
Key Characteristics:

- poorly drained (wet) and well-drained soil types occur, both often slightly richer than mesotrophic.
- seepage waters and/or root-restricting water tables may occur in the upper 60 cm of fine textured mineral horizons.
- relatively low coarse fragment content in both profile types.
- mottling common in fine textured subsurface horizons.
- organic horizons range from 6 to 13 cm in depth, often containing a well-decomposed horizon (H) that supports abundant rooting.

ICHg2: LOWER NASS BASIN VARIANT

/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION (223)


Tiarella trifoliata
three-leaved foamflower
Rubus parviflorus
thimbleberry
Oplopanax horridus
devil's club
Athyrium filix-femina
lady fern
Dryopteris assimilis
spiny wood fern
Circaea alpina
enchanter's nightshade
Mnium spp
Gymnocarpium dryopteris
oak fern


A B C D E
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7

ECOLOGICAL MOISTURE REGIME:
(subhygric) - hygric

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - eutrophic

DISTRIBUTION: found throughout the ICHg2; small pockets of this ecosystem association are common but stands of significant size are rare.

PHYSIOGRAPHIC FEATURES:
Slope position: lower and toe slopes, valley floors, drainage channels and gulleys; sites receiving abundant seepage moisture.
Slope range: usually gently sloping or level.
Surface shape: normally slightly concave or flat, irregular.
Landforms: morainal (colluvial) deposits, frequently washed; fluvial deposits.

ICHg2/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: large, widely spaced; canopy often irregular with openings; composition variable.

hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	
western redcedar	(*Thuja plicata*)	
subalpine fir	(*Abies lasiocarpa*)	
western hemlock	(*Tsuga heterophylla*)	-generally confined to subcanopy layers
[black cottonwood	(*Populus balsamifera* ssp. *trichocarpa*)]	

Shrubs: usually a well-developed, vigorous layer.

devil's club	(*Oplopanax horridus*)	-totally dominates shrub layer, vigorous
black gooseberry	(*Ribes lacustre*)	
[thimbleberry	(*Rubus parviflorus*)]	
[highbush-cranberry	(*Viburnum edule*)]	

Herbs: usually a well-developed, vigorous layer; moderately high species diversity.

oak fern	(*Gymnocarpium dryopteris*)	-dominates hero layer
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
sweet-scented bedstraw	(*Galium triflorum*)	
common mitrewort	(*Mitella nuda*)	
enchanter's nightshade	(*Circaea alpina*)	
spiny wood fern	(*Dryopteris assimilis*)	
clasping twistedstalk	(*Streptopus amplexifolius*)	
[lady fern	(*Athyrium filix-femina*)]	-not always present, rarely dominant
[violet	(*Viola* spp.)]	
[bunchberry	(*Cornus canadensis*)]	)-confined to
[one-sided wintergreen	(*Orthilia secunda*)]	) high spots and
[green wintergreen	(*Pyrola chlorantha*)]	) decaying wood
[single delight	(*Moneses uniflora*)]	)

Moss layer: poorly to moderately well-developed, feathermosses confined mainly to high spots and decaying wood.

[*Mnium* spp.]
Hylocomium splendens
Ptilium crista-castrensis
Brachythecium spp.

Remarks: This ecosystem association has not been sufficiently sampled, particularly in western parts of the ICHg2. It seems to have a low cover of lady fern, spiny wood fern, and leafy mosses and a high cover of feather moss compared with examples of the Devil's club - fern - leafy moss e.a. in the ICHg1 and g3 variants. Development of the ferns and leafy mosses is probably better in the Nass Valley, where continental climatic influences are less strong.

This is a very productive ecosystem association for spruce, cedar, and subalpine fir. Hemlock seems to be restricted to elevated microsites and decaying wood and does not perform as well as the other species. Seral stands often contain cottonwood that may persist until the climax is fairly well-established.

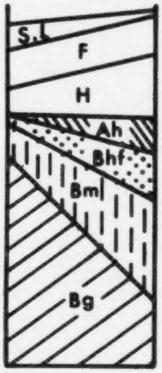
ICHg2/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles generally show evidence of abundant moisture that accumulates in receiving slope positions. Organic materials often accumulate in surface mineral horizons giving them a dark brown appearance (Ah, Bhf horizons). Well-drained, reddish-brown (Bm or Bf) mineral horizons are often underlain by wetter, imperfectly drained horizons that may be massive in structure and saturated for significant periods of time. Mottling and/or seepage commonly occur within 40 cm of the mineral surface. Organic horizons often accumulate to depths greater than 15 cm, with evidence of both fungal and zoogeneous decomposition.

Soil Classification: Orthic Gleysols and Gleyed Eutric Brunisols.

Humus Form Classification: Amphimormoders; Orthihemihumimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; light to dark brown; plentiful fine, medium roots.
H	- well-decomposed; dark brown organic horizon; abundant medium, coarse roots.
(Ah) (Bhf)	- dark brown to dark reddish-brown; loam to silt loam; plentiful medium, coarse roots.
Bm	- light to dark brown; loam to clay loam; very moist to wet; few to plentiful fine roots.
Bg	- wet subsurface horizons; grayish-brown to olive brown; massive to angular blocky; common prominent mottling; few roots.

Orthic Gleysol

Average pH: mineral horizons - 4.2 (limited data)
organic horizons - 5.2 (limited data)

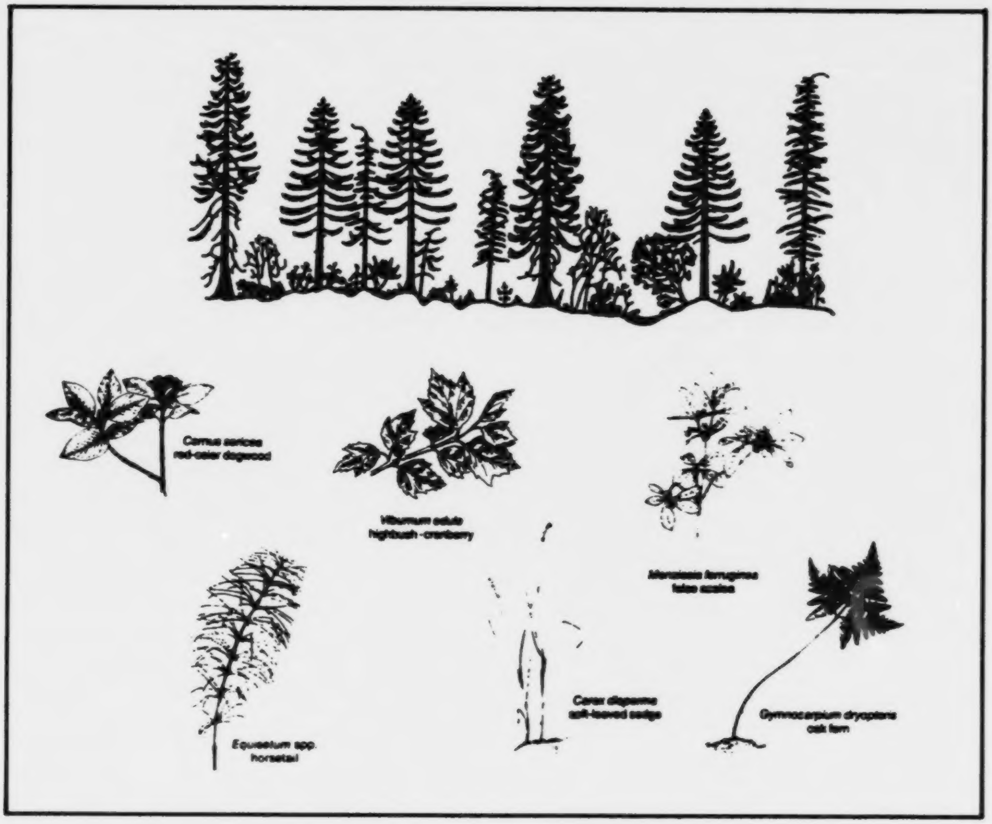
Key Characteristics:

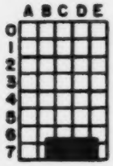
- subsurface horizons are often compacted and massive, thus restricting water flow and root penetration at depths greater than 60 cm.
- seepage waters commonly occur within 30 cm of the mineral surface and promote abundant rooting.
- surface mineral horizons (Ah, Bhf) have accumulated significant quantities of organic matter that aid in storage of moisture and nutrients.
- surface organic materials are often thicker than 15 cm and commonly exist in an advanced stage of decomposition.
- frost heaving may be a problem.

Comments: Vegetative rooting may be shallow in these soils, which commonly contain massive, compact subsurface horizons that restrict air and water flow. Surface horizons are relatively nutrient-rich and support abundant rooting.

ICHg2: LOWER NASS BASIN VARIANT

/06 HORSETAIL SWAMP ECOSYSTEM ASSOCIATION (224)


Cornus sericea
red-osier dogwood
Viburnum edule
highbush-cranberry
Menziesia ferruginea
false azalea
Equisetum spp.
horsetail
Carex disperma
soft-leaved sedge
Gymnocarpium dryopteris
oak fern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ECOLOGICAL MOISTURE REGIME:
hygric+ - subhydric

ECOLOGICAL NUTRIENT REGIME:
(submesotrophic) - permesotrophic

DISTRIBUTION: this ecosystem association is found throughout the ICHg2, but it is not common and stands are never very large.

PHYSIOGRAPHIC FEATURES:
Slope position: valley floors, slope bases, depressions in slope benches; sites collecting moisture.
Slope range: gently sloping to level.
Surface shape: concave or flat, often very hummocky.
Landforms: organic veneer over morainal, fluvial or lacustrine deposits.

ICHg2/06 HORSETAIL SWAMP ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: variable size, normally short; canopy open and irregular.

western redcedar	(*Thuja plicata*)	-frequently dominant cover
western hemlock	(*Tsuga heterophylla*)	
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-sporadic, usually low vigour

Shrubs: generally a well-developed but patchy layer; variable composition.

false azalea	(*Menziesia ferruginea*)	)-prominent on raised hummocks and decaying wood
oval-leaved blueberry	(*Vaccinium ovalifolium*)	)
red-osier dogwood	(*Cornus sericea*)	
highbush-cranberry	(*Viburnum edule*)	
[devil's club	(*Oplopanax horridus*)]	
[black gooseberry	(*Ribes lacustre*)]	
[thimbleberry	(*Rubus parviflorus*)]	

Herbs: a well-developed layer; diverse species composition.

horsetails	(*Equisetum arvense*, *E. pratense*, *E. sylvaticum*)	-characteristic dominant herb
oak fern	(*Gymnocarpium dryopteris*)	
soft-leaved sedge	(*Carex disperma*)	-excellent indicator species
three-leaved foamflower	(*Tiarella trifoliata*)	
[twistedstalks	(*Streptopus amplexifolius*, *S. roseus*)]	
[heart-leaved twayblade	(*Listera cordata*)]	
[trailing raspberry	(*Rubus pubescens*)]	
[common mitrewort	(*Mitella nuda*)]	
[nodding wood-reed	(*Cinna latifolia*)]	
[stiff club-moss	(*Lycopodium annotinum*)]	
[bunchberry	(*Cornus canadensis*)]	)-prominent on hummocks and decaying wood
[five-leaved bramble	(*Rubus pedatus*)]	)
[single delight	(*Moneses uniflora*)]	)

Moss layer: well-developed; diverse species composition.

Mnium spp.	-dominant in wet, low spots
Hylocomium splendens	)-dominant on high spots and decaying wood
Ptilium crista-castrensis	)
Rhytidiadelphus triquetrus	)
Pleurozium schreberi	)
[*Sphagnum* spp.]	

Remarks: Tree productivity in Horsetail swamp ecosystems is extremely variable and seems to depend on the nutrient status and the degree of soil aeration. Swamps can range from relatively productive stands of spruce and cedar to submarginal stands dominated by stunted hemlock growing on hummocks of accumulated organic matter. The degree to which "moist/rich" indicator species like oak fern, foamflower and devil's club dominate over "wet/poor" indicators like horsetail, sedge, and Sphagnum moss is a good indication of the potential for tree growth. Skunk cabbage is generally absent from swamps in the ICHg2, but it may appear in this ecosystem unit near the border with the Coastal Western Hemlock Zone.

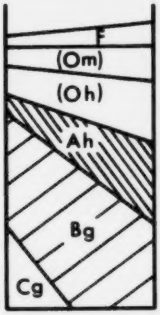
ICHg2/06 HORSETAIL SWAMP ECOSYSTEM ASSOCIATION

SOILS: Soil profiles are dominated by thick organic layers with or without underlying mineral horizons. These soils form in depressions or at the toe of slopes where water tables are close to the surface. The wet poorly aerated conditions slow rates of decomposition and lead to an accumulation of surface organic materials. Subsurface mineral horizons have bluish gray to very dark brown colouration and have very compacted, massive structures that are impenetrable to air, free flowing water, or roots. Surface mineral horizons (Ah), if present, may be moderately well-drained and generally show an accumulation of organic matter, as indicated by dark brown colours.

Soil Classification: Orthic Gleysols; Orthic Humic Gleysols; Terric Mesisols.

Humus Form Classification: Saprihistomoders (wet) and Amphimormoders.

Schematic Profile:



Orthic Humic Gleysol
(Terric Mesisol)

Horizon	Description
(Om)	- poorly aerated; black; moderately decomposed; wet; mushy; few fine, medium roots; variable depth.
(Oh)	- poorly aerated; black; well-decomposed; wet; mushy; few fine roots.
Ah	- very dark brown; silt loam; granular to massive; few to abundant medium, coarse roots.
Bg	- dark gray to olive gray; clay loam; massive; few roots; very moist to wet; abundant mottling.

Average pH: mineral horizons - 5.9 (limited data)
organic horizons - 4.0

Key Characteristics:

- compacted subsurface mineral layers, often containing abundant organic matter, are wet for most of the growing season, with limited free air and water flow (poor drainage).
- water tables and/or seepage can often be found within 30 cm of the top of the organic horizons.
- abundant, vivid mottles present in mineral horizons.

Comments: Effective rooting is generally restricted to well-aerated surface organic (F) and mineral layers (Ah) that are not permanently saturated with water. Additional drainage systems (ditching) may improve trafficability and fertility on these marginal sites.

/07 FLOODPLAIN COTTONWOOD SERAL ECOSYSTEM ASSOCIATION (225)

Remarks: Stands of cottonwood are common on the active floodplains of the Nass River and the lower reaches of its tributaries in the ICHg2. They are generally absent from the mid-elevation belt of the ICHg2 above the Skeena and Bulkley valleys. The description and management interpretations of the Floodplain cottonwood seral ecosystem association in the ICHg3 variant (ICHg3/11) also apply very well to the floodplain forests of the ICHg2.

ICHg2: LOWER NASS BASIN VARIANT

SERAL VARIATIONS

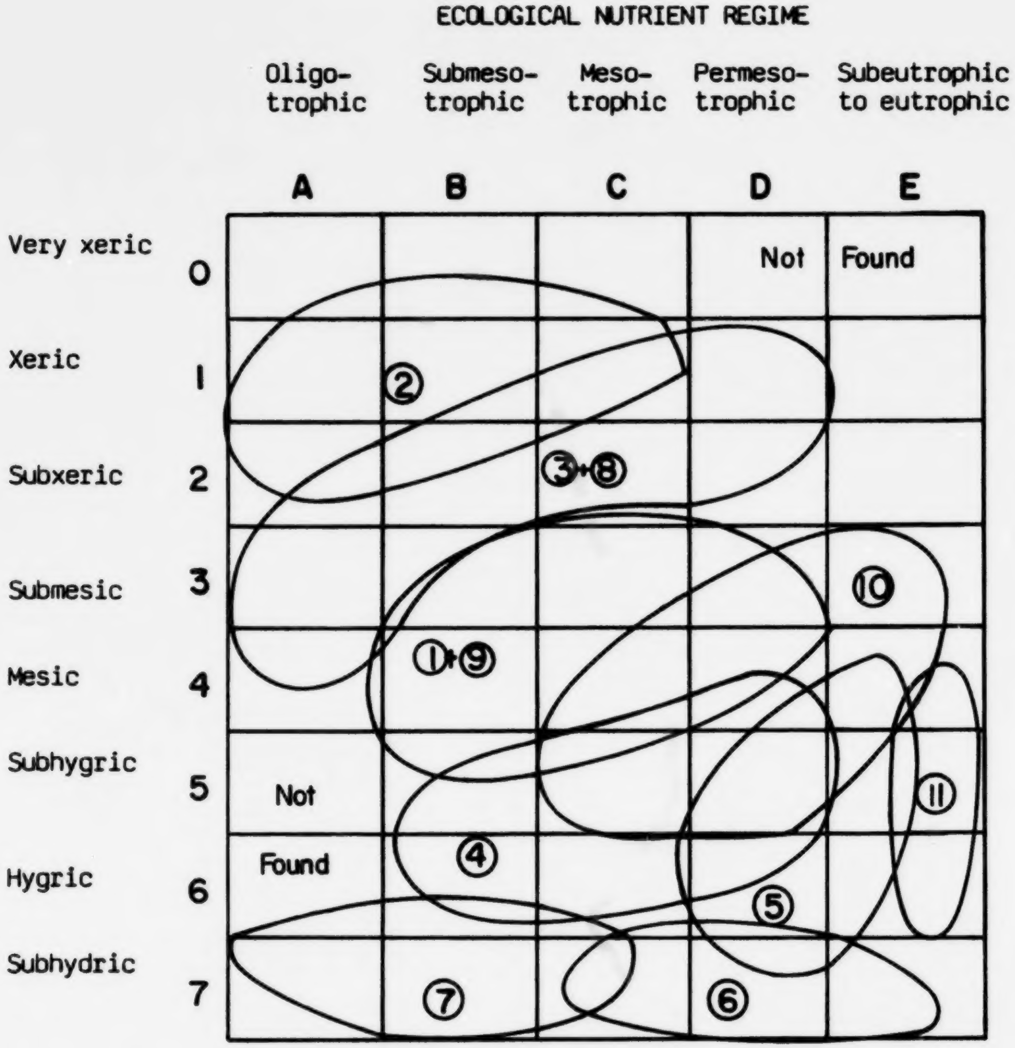
Remarks: We have not given detailed descriptions of seral variations for any of the ecosystem associations in the ICHg2. Seral or successional stands are widespread at low elevations in the Nass Valley portion of the ICHg2. They are also present, but less common, in the Skeena - Bulkley Valley portion. Many seral stands already bear a strong resemblance to the climax stand into which they will eventually develop. Such stands are easily assigned to one of the ecosystem associations described on the preceding pages. Management interpretations for the ecosystem unit should also apply to these stands. Note, however, that the brush hazard of these sites is often significantly increased because of the presence of deciduous tree species and seral shrubs. Abundant advance regeneration of subalpine fir may also be present and may create regeneration problems after logging. In the ICHg2, particularly near its border with the ICHg3, you may also encounter seral stands which give little indication of the kind of climax forest into which they will evolve. These are primarily stands with a heavy component of trembling aspen or paper birch in the overstory. They typically have very dense shrub and herb layers, dominated by species like red-osier dogwood (*Cornus sericea*), thimbleberry (*Rubus parviflorus*), hazelnut (*Corylus cornuta*), purples peavine (*Lathyrus nevadensis*), wild sarsaparilla (*Aralia nudicaulis*), star-flowered false Solomon's-seal (*Smilacina stellata*), and various species of grass. There is little or no moss layer. When you encounter a stand like this in the field, please refer to an appropriate seral ecosystem association description for the ICHg3 variant, and follow the management guidelines for that unit.

7.4 Classification of Ecosystem Units of the ICHg3: Hazelton Variant

- /01 Zonal hemlock - moss ecosystem association
  - /01.1 Hemlock - (cedar) subassociation
    - /01.1(a) coarse textured phase
    - /01.1(b) fine textured phase
  - /01.2 Subalpine fir - spruce subassociation
    - /01.2(a) coarse textured phase
    - /01.2(b) fine textured phase
- /02 Pine - lichen ecosystem association
- /03 Dry hemlock - moss ecosystem association
  - /03(a) lithic phase
  - /03(b) coarse textured phase
- /04 Devil's club - oak fern - feather moss ecosystem association
  - /04.1 Hemlock - cedar subassociation
  - /04.2 Spruce subassociation
- /05 Devil's club - fern - leafy moss ecosystem association
- /06 Horsetail - (skunk cabbage) swamp ecosystem association
- /07 Black spruce - peat moss ecosystems

Seral ecosystem associations:

- /08 Pine - soopolallie seral ecosystem association
- /09 Spruce - pine - shrub seral ecosystem association
  - /09(a) coarse textured phase
  - /09(b) fine textured phase
- /10 Aspen - birch - red-osier dogwood seral ecosystem association
  - /10(a) hazelnut fluvial phase
- /11 Floodplain cottonwood seral ecosystem association

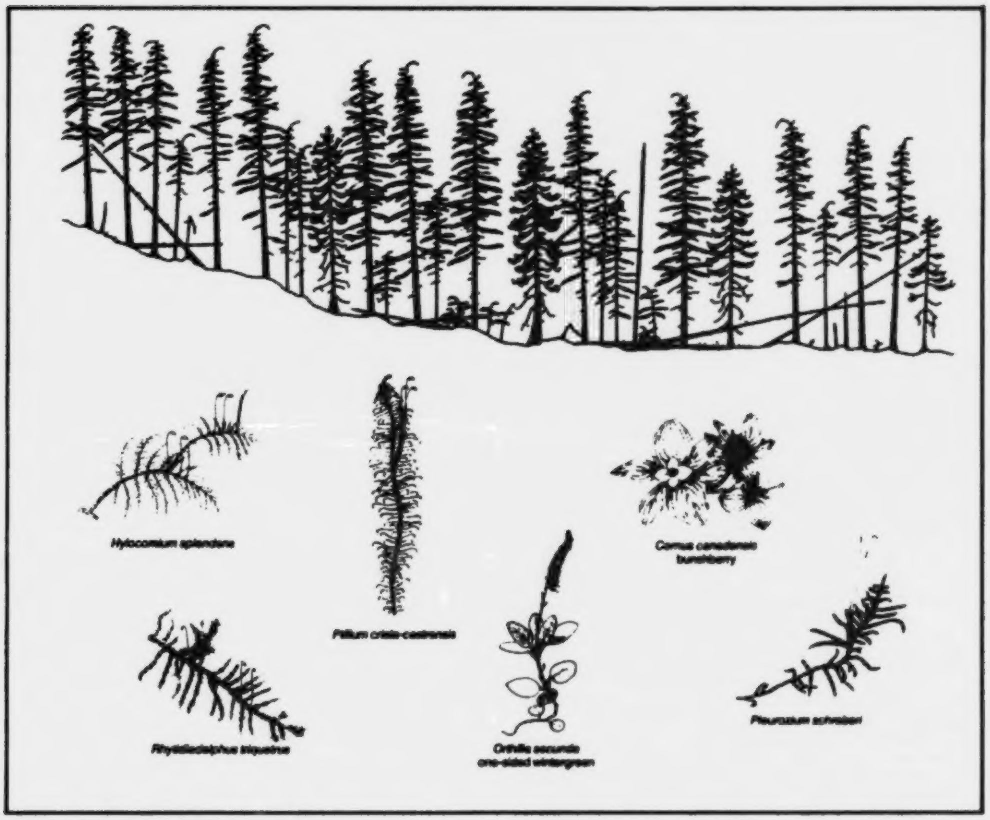

ECOLOGICAL NUTRIENT REGIME
Oligo-trophic
Submeso-trophic
Meso-trophic
Permeso-trophic
Subeutrophic to eutrophic
A
B
C
D
E
Very xeric
0
Not
Found
Xeric
1
②
Subxeric
2
③+⑧
Submesic
3
⑩
Mesic
4
①+⑨
Subhygric
5
Not
⑪
Hygric
6
Found
④
⑤
Subhydric
7
⑦
⑥

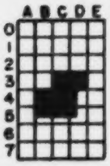
① ZONAL HEMLOCK - MOSS
② PINE - LICHEN
③ DRY HEMLOCK - MOSS
④ DEVIL'S CLUB - OAK FERN
⑤ DEVIL'S CLUB - FERN - LEAFY MOSS
⑥ HORSETAIL - (SKUNK CABBAGE) SWAMP
⑦ BLACK SPRUCE - PEAT MOSS
⑧ PINE - SOAPBERRY
⑨ SPRUCE - PINE - SHRUB
⑩ ASPEN - BIRCH - RED-OSIER DOGWOOD
⑪ FLOODPLAIN COTTONWOOD

FIGURE 14. Edatopic grid of ecological moisture and nutrient regimes - ICHg3.

ICHg3: HAZELTON VARIANT

/01.1 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION, HEMLOCK - (CEDAR) - SUBASSOCIATON (228)[11]


Hylocomium splendens
Ptilium crista-castrensis
Cornus canadensis
bunchberry
Rhytidiadelphus triquetrus
Orthilia secunda
one-sided wintergreen
Pleurozium schreberi


A B C D E
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ECOLOGICAL MOISTURE REGIME:
submesic - mesic

ECOLOGICAL NUTRIENT REGIME:
mesotrophic

DISTRIBUTION: occurs widely throughout the ICHg3; most common above main valley floors and on north aspects.

PHYSIOGRAPHIC FEATURES:

Slope position: mainly mid-slopes, extending to upper and rarely lower slopes, valley floors, benches, and terraces.
Slope range: mostly gently sloping; level to moderately steep (0 - 50%).
Surface shape: straight, slightly concave or convex, flat.
Landforms: morainal blankets and veneers; glaciofluvial terraces, kames; fluvial deposits; rarely lacustrine or colluvial deposits.

---

[11] Number in parentheses is the page number of appropriate silvicultural prescription.

ICHg3/01.1 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION, HEMLOCK - (CEDAR) - SUBASSOCIATION

VEGETATION:

Trees: rather small; stand often dense.

western hemlock	(*Tsuga heterophylla*)	-dominant cover
[lodgepole pine	(*Pinus contorta*)]	-scattered in and above main canopy
[western redcedar	(*Thuja plicata*)]	-mainly in subcanopy layers
[subalpine fir	(*Abies lasiocarpa*)]	-generally poor growth
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-tallest tree in some stands

Shrubs: very poorly developed layer; little coniferous regeneration.

[black huckleberry	(*Vaccinium membranaceum*)]	
[Saskatoon	(*Amelanchier alnifolia*)]	)-dying seral
[Douglas maple	(*Acer glabrum*)]	) remnants
[falsebox	(*Paxistima myrsinites*)]	

Herbs: very poorly developed layer, scattered individuals or small groups; may include one or more of:

[one-sided wintergreen	(*Orthilia secunda*)]
[bunchberry	(*Cornus canadensis*)]
[prince's pine	(*Chimaphila umbellata*)]
[green wintergreen	(*Pyrola chlorantha*)]
[round-leaved rein-orchid	(*Platanthera orbiculata*)]
[queen's cup	(*Clintonia uniflora*)]
[twinflower	(*Linnaea borealis*)]

Moss layer: a well-developed carpet of mosses.

Hylocomium splendens
Ptilium crista-castrensis
Pleurozium schreberi
Rhytidiadelphus triquetrus

Remarks: This subassociation represents the climatic climax ecosystem for the ICHg3. On many of the zonal sites in the ICHg3 this subassociation has long been replaced by well-established and persistent seral ecosystem associations (ICHg3/09 + /10). Thus, the Hemlock (cedar) subassociation of the zonal e.a. is uncommon in the ICHg3. It is found mainly at the higher elevations of the variant, away from the main valley floors and particularly on north-facing slopes where fires have had the least impact.

Most mature examples of the ICHg3/01.1 still contain remnants of earlier successional stages. Lodgepole pine is common in the overstory and overmature birch trees are scattered in many stands. Shade-intolerant shrubs such as Saskatoon, Douglas maple, thimbleberry, (*Rubus parviflorus*), prickly rose (*Rosa acicularis*) and soopolallie (*Shepherdia canadensis*) are also occasionally present, but their vigour is very poor under the closed tree canopy. Advance regeneration is sparse, but it indicates clearly the successional trend of the stand since it consists almost entirely of hemlock and cedar.

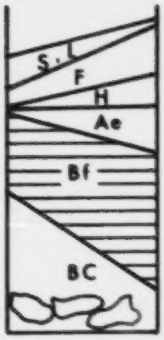
ICHg3/01.1(a) ZONAL HEMLOCK - MOSS, HEMLOCK - (CEDAR) - SUBASSOCIATION: COARSE TEXTURED PHASE

SOILS: Zonal soils are found on mid-slope positions that generally have moderate amounts of moisture and nutrients. Soil profiles show reddish brown surface mineral horizons indicative of podzolic development. These loamy to sandy Bf horizons extend 20 to 30 cm before changing colour to a lighter yellowish brown (BC) subsurface mineral horizon. Light brownish gray surface mineral horizons (Ae) overlie reddish Bf horizons and are generally 2-5 cm in thickness. Organic materials have developed as acidic mor humus forms, ranging from 5 to 12 cm in thickness, with F horizons dominating.

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
S,L	- moss layer and discontinuous loose litter; undecomposed.
F	- partially decomposed; brown to dark brown; plentiful fine, medium roots; abundant white and yellow mycelia.
Ae	- light brownish gray to yellowish brown; loam; few medium roots; very acidic.
Bf	- reddish to strong brown; loam to sand; plentiful fine, medium, coarse roots.
BC	- yellowish brown; sand to silt loam; few fine, medium roots; may contain high coarse fragment volume.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.8
organic horizons - 3.5

Key Characteristics:
- deep loamy sand to loamy mineral horizons that are well-drained.
- effective rooting relatively deep (40 - 90 cm).
- subsurface mineral horizons may have an abundance of coarse fragments that promote rapid drainage.
- acidic, Mor humus forms, weakly to moderately decomposed.
- formed on washed morainal blankets, glaciofluvial, or fluvial landforms, commonly at mid-slope positions.

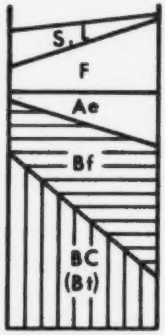
ICHg3/01.1(b) ZONAL HEMLOCK - MOSS, HEMLOCK - (CEDAR) - SUBASSOCIATION: FINE TEXTURED PHASE

SOILS: Soils are generally fine textured and have developed on thick morainal blankets. Profiles are generally characterized by loamy, yellowish brown mineral horizons, often underlain by finer textured (silt loam to clay loam) subsurface horizons of relatively low coarse fragment content. Lower mineral horizons (Bt) may show some evidence of clay translocation in the form of shiny clay skins on ped surfaces and/or in pores, although this feature may only be weakly expressed. Organic horizons generally range from 5 to 12 cm in total thickness.

Soil Classification: Luvisolic Humo-Ferric Podzols and Podzolic Gray Luvisols with minor Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Orthic Humo-Ferric Podzol
(Podzolic Gray Luvisol)

Horizon	Description
F	- moderately decomposed organic materials; dark brown; common to abundant fungal mycelia; acidic.
Ae	- pale brown; loamy sand; acidic.
Bf	- brown; loamy; plentiful to abundant medium fine roots; 20% coarse fragments common.
BC	- yellowish brown to grayish brown; silty clay loam to loam.

Average pH: mineral horizons - 4.9
organic horizons - 3.6

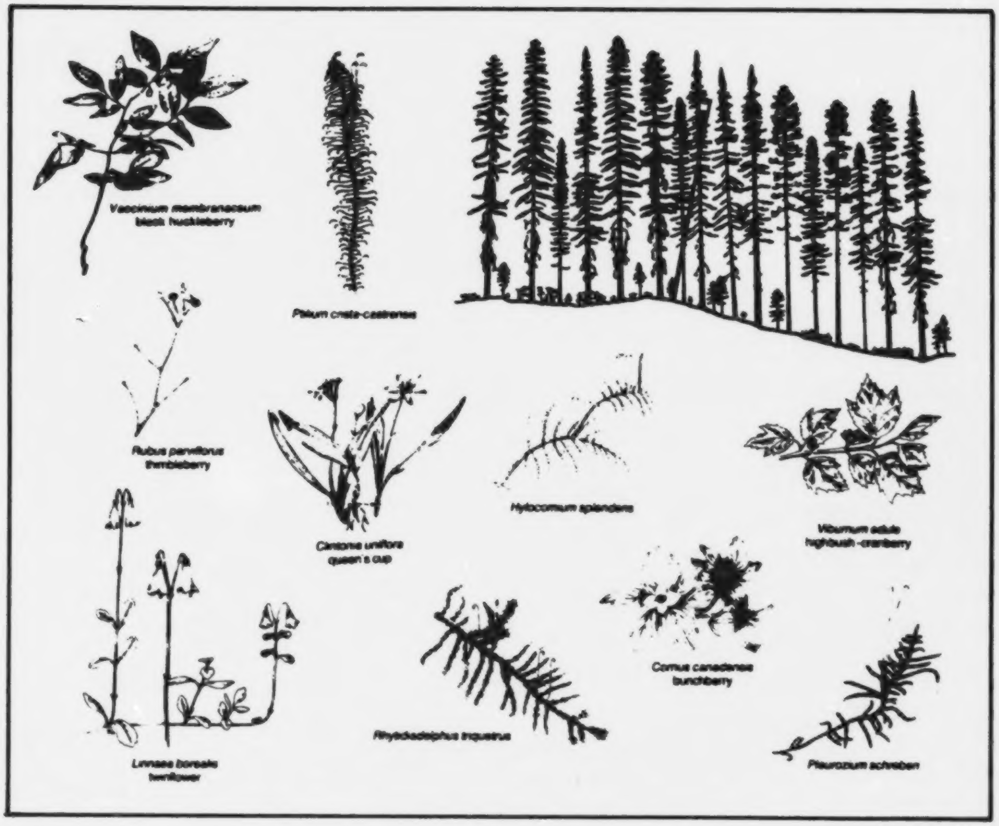
Key Characteristics:

- generally fine textured soils showing increased luvisolic (Bt) development when compared to podzolic zonal soils.
- soils usually well-drained although periodic seepage and faint mottles may occur below 50 cm.
- relatively low coarse fragment in surface mineral horizons when compared to mesic or drier ecosystem associations.

Comments: Rooting is relatively deep in these fine textured soils, which usually have an adequate supply of moisture and nutrients for most of the growing season.

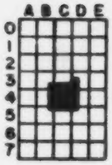
ICHg3: HAZELTON VARIANT

/01.2 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION, SUBALPINE FIR - SPRUCE SUBASSOCIATION (229)


Vaccinium membranaceum
black huckleberry
Ptilium crista-castrensis
Rubus parviflorus
thimbleberry
Clintonia uniflora
queen's cup
Hylocomium splendens
Viburnum edule
highbush-cranberry
Linnaea borealis
twinflower
Rhytidiadelphus triquetrus
Cornus canadensis
bunchberry
Pleurozium schreberi

ECOLOGICAL MOISTURE REGIME:
(submesic+) - mesic

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - (permesotrophic)



DISTRIBUTION: found in eastern sections of the ICHg3 where sub-boreal climatic influences are strong. Typical at low elevations in the upper Kitseguecla and lower Kispiox River valleys. Often found in areas of cold air drainage.

PHYSIOGRAPHIC FEATURES:

Slope position: mid-slope, extending to upper and lower slopes; valley floor.

Slope range: gently to moderately sloping; level.

Surface shape: variable; straight to irregularly convex or concave; flat.

Landforms: morainal blankets; glaciofluvial deposits.

ICHg3/01.2 ZONAL HEMLOCK - MOSS ECOSYSTEM ASSOCIATION, SUBALPINE FIR - SPRUCE SUBASSOCIATION

VEGETATION:

Trees: moderate to good growth; variable species composition.

subalpine fir	(*Abies lasiocarpa*)	-especially dominant in understory layers
lodgepole pine	(*Pinus contorta*)	-common seral dominant, drops out in older stands
hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	-dominant in height
[western hemlock	(*Tsuga heterophylla*)]	-infrequent, mainly in subcanopy
[paper birch	(*Betula papyrifera*)]	-common in younger stands, persistent

Shrubs: generally moderately to well-developed; abundant subalpine fir reproduction.

black huckleberry	(*Vaccinium membranaceum*)	
thimbleberry	(*Rubus parviflorus*)	
highbush-cranberry	(*Viburnum edule*)	
[prickly rose	(*Rosa acicularis*)]	)-seral species,
[Saskatoon	(*Amelanchier alnifolia*)]	) disappearing in
[soopolallie	(*Shepherdia canadensis*)]	) older stands
[Sitka alder	(*Alnus viridis* ssp. *sinuata*)]	)

Herbs: well-developed compared to ecosystems of Hemlock - (cedar) subassociation.

bunchberry	(*Cornus canadensis*)	
queen's cup	(*Clintonia uniflora*)	
twinflower	(*Linnaea borealis*)	
prince's pine	(*Chimaphila umbellata*)	
green wintergreen	(*Pyrola chlorantha*)	
[false Solomon's-seal	(*Smilacina racemosa*)]	)-predominantly
[wild sarsaparilla	(*Aralia nudicaulis*)]	) seral species,
[purple peavine	(*Lathyrus nevadensis*)]	) diminishing in
[trailing raspberry	(*Rubus pubescens*)]	) importance as stand ages
[five-leaved bramble	(*Rubus pedatus*)]	-unusual in the ICHg3

Moss layer: a well-developed moss carpet.

Ptilium crista-castrensis
Pleurozium schreberi
Rhytidiadelphus triquetrus
Hylocomium splendens

Remarks: The Subalpine fir - spruce subassociation is theoretically a seral stage that would eventually develop into a hemlock - (cedar) - moss climax. However, indications are that these stands are self-perpetuating for at least 100 years. As the stand ages, lodgepole pine and birch drop out and are replaced by subalpine fir and spruce. Hemlock and cedar may remain minor components of the stand because local climate restricts their reproduction.

These stands occur close to the border of the Sub-Boreal Spruce biogeoclimatic zone (SBS) and resemble the climatic climax ecosystems of that zone. However, hemlock - (cedar) climax forest dominates the surrounding slopes and occurs as scattered, relict stands in the valley bottoms, and it appears that the subalpine fir - spruce stands occur where fires have been more frequent and where a localized sub-boreal climate prevails because of cold air ponding on valley floors.

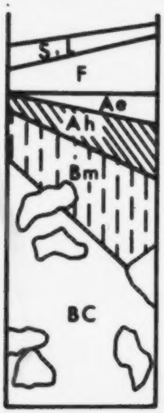
ICHg3/01.2(a & b) ZONAL HEMLOCK - MOSS, SUBALPINE FIR - SPRUCE SUBASSOCIATION: COARSE AND FINE TEXTURED PHASES (cf. ICHg3/01.1(a & b))

SOILS: Both coarse and fine textured soils have developed in this ecosystem association. Dark brown (Ah) and/or dark yellowish brown (Bm) mineral horizons occur near the mineral surface, and have sandy loam to silt loam texture. Subsurface mineral horizons are either coarse in texture (on glaciofluvial deposits) or of fine clayey texture (morainal blankets). Both types of soil have a coarse fragment volume greater than 35% through- out the profiles, which significantly improves subsurface drainage. Clay skins commonly develop below 30 cm in pores and/or on coarse fragments, indicating clay movement through the profile. Organic materials generally range from 4 to 7 cm in depth.

*Soil Classification: Eluviated Sombric Brunisols; Podzolic and Brunisolic Gray Luvisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- moderately decomposed; brown to dark; plentiful fine, medium roots.
Ae	- pale brown; loam; few medium roots; acidic.
Ah	- dark brown to black; silt loam; granular; plentiful medium, coarse roots.
Bm	- brown to grayish brown; sandy loam to silt loam; plentiful fine, medium roots; granular structure.
BC	- yellowish brown; loam; few fine roots.
(Bt)	- dark grayish brown; clay loam; angular blocky; common clay skins on ped faces and/or in pores; few fine roots.

Eluviated Sombric Brunisol
(Brunisolic Gray Luvisol)

*Average pH: mineral horizons - 5.1
organic horizons - 3.3

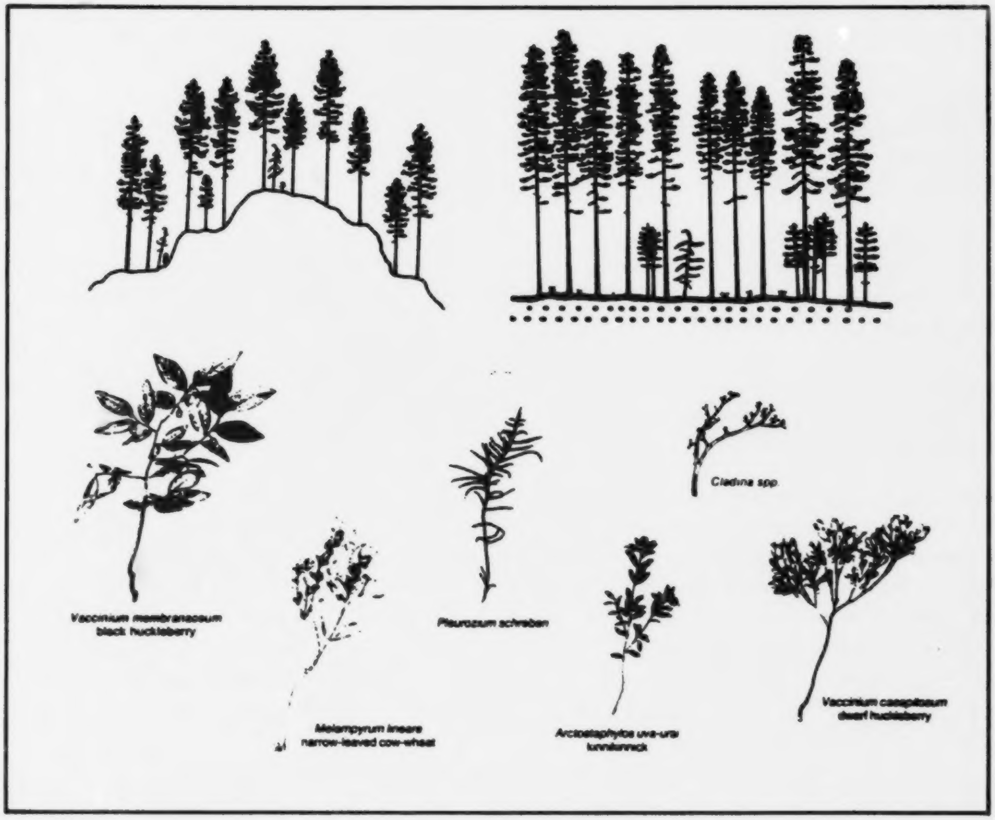
Key Characteristics:

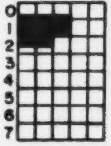
- subsurface mineral horizons may be enriched in clay (Bt) and compacted, and may impede root penetration.
- soils appear to be slightly richer than mesotrophic, with fine textures and/or surface accumulation of organic matter in coarser glaciofluvial deposits.
- soils have a relatively high capacity to retain water.
- relatively high subsurface coarse fragment content (below 40 cm) aids drainage.
- surface mineral horizons may have frost-heaving hazard.

*NOTE: sampling of this subassociation was limited.

ICHg3: HAZELTON VARIANT

/02 PINE - LICHEN ECOSYSTEM ASSOCIATION (230)


Vaccinium membranaceum
black huckleberry
Melampyrum lineare
narrow-leaved cow-wheat
Pleurozium schreberi
Cladina spp.
Arctostaphylos uva-ursi
kinnikinnick
Vaccinium caespitosum
dwarf huckleberry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ECOLOGICAL MOISTURE REGIME:
xeric - (subxeric)

ECOLOGICAL NUTRIENT REGIME:
(oligotrophic) - submesotrophic

DISTRIBUTION: occurs frequently on exposed and rapidly drained sites along the Skeena and Bulkley rivers, uncommon elsewhere; minor extent and importance.

PHYSIOGRAPHIC FEATURES:
Slope position: slope apices and ridge crests, terraces; exposed shedding positions.
Slope range: level to moderately sloping (0 - 25%).
Surface shape: convex, irregularly mounded; flat.
Landforms: rock outcrops; glaciofluvial outwash terraces; eskers.

ICHg3/02 PINE - LICHEN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: small, low vigour; spacing open to quite dense.

lodgepole pine	(Pinus contorta)

Shrubs: a low-lying layer, poorly to moderately developed.

black huckleberry	(Vaccinium membranaceum)
[Scouler's willow	(Salix scouleriana)]
[Saskatoon	(Amelanchier alnifolia)]
[soopolallie	(Shepherdia canadensis)]
[prickly rose	(Rosa acicularis)]

Herbs: poorly to moderately well-developed layer.

dwarf blueberry	(Vaccinium caespitosum)	)-all good dry-site
kinnikinnick	(Arctostaphylos uva-ursi)	) indicators
narrow-leaved cow-wheat	(Melampyrum lineare)	)
prince's pine	(Chimaphila umbellata)	)
twinflower	(Linnaea borealis)	)
western fescue	(Festuca occidentalis)	)
ricegrasses	(Oryzopsis asperifolia, O. pungens)	))
white-flowered hawkweed	(Hieracium albiflorum)	)

Moss layer: a mixture of mosses and lichens; drier sites have more lichens.

Pleurozium schreberi	-dominant moss
Cladina spp.	)-lichens
Peltigera spp.	)
Cladonia spp.	)
Stereocaulon spp.	)
[Polytrichum juniperinum]	)-characteristic
[Dicranum polysetum]	) dry-site mosses
[Rhacomitrium spp.]	)

Remarks: This ecosystem association occurs on the driest, most extreme sites in the ICHg3. It also appears, but to a lesser extent, in the g1 and g2 variants. Pine is maintained by frequent fire and even reproduces sometimes in stand openings. The trees are short and small in diameter. Radial growth may be quite good in very young stands but it tapers off rapidly as the stand begins to close. These ecosystems are submarginal for commercial timber production.

Hemlock reproduction may appear in understory layers but generally dies back when the overstory of pine is removed. The extreme droughtiness of these habitats is reflected in the lack of species such as bunchberry (Cornus canadensis), Hylocomium splendens, and Ptilium crista-castrensis.

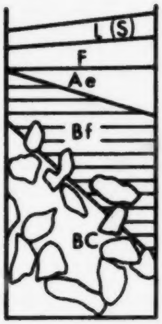
ICHg3/02 PINE - LICHEN ECOSYSTEM ASSOCIATION

SOILS: These soils occur as dry shallow deposits, rapidly drained and leached of nutrient cations. Although sampling of this association was limited, certain features were noted. Soil profiles are characterized by strong brown (Bf) and/or yellowish brown (Bm) loamy sandy mineral horizons containing a high volume of coarse fragments (often greater than 40%), which contribute to rapid drainage. Very coarse subsurface horizons may extend to depths greater than 1 m, or may be intruded by bedrock at fairly shallow depths. Organic horizons are very thin, often between 3 and 5 cm thick and may lack moisture for the majority of the growing season.

Soil Classification: major Orthic Humo-Ferric Podzols and minor Eluviated Dystric Brunisols.

Humus Form Classification: Orthixeromors; Orthihemimors.

Schematic Profile:



Horizon	Description
L(S)	- dry, loose, needle and twig litter with thin moss accumulation.
F	- brown; moderately decomposed; compact matted.
Bf	- strong to dark yellowish brown; loamy sand to sands; structureless; few to plentiful fine, medium, coarse roots; abundant gravels.
BC	- light yellowish-brown; loose gravelly sands; few to plentiful fine roots; bedrock may occur.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.3 (limited data)
organic horizons - 3.7 (limited data)

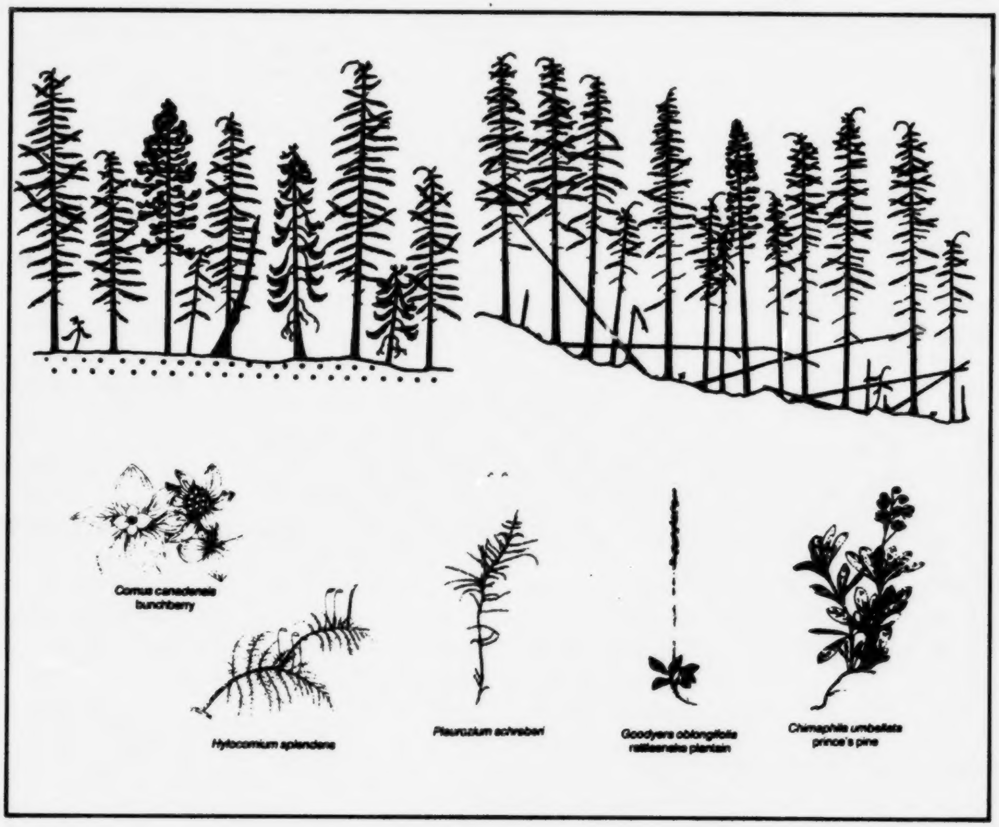
Key Characteristics:

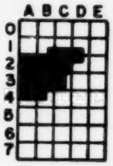
- soils developed from either coarse textured glaciofluvial outwash or morainal veneers over bedrock (both rapidly drained).
- generally deep rooting (where possible), to satisfy moisture requirements.
- very thin organic horizons (3-5 cm) suggest a low capacity for water interception or retention.

Comments: Because of their thin humus and coarse soils (which are often shallow), these ecosystems are sensitive and highly susceptible to erosion. Moisture deficiencies would be expected for a significant part of the growing season.

ICHg3: HAZELTON VARIANT

/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION (231)


Cornus canadensis
bunchberry
Hylocomium splendens
Pleurozium schreberi
Goodyera oblongifolia
rattlesnake plantain
Chimaphila umbellata
prince's pine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ECOLOGICAL MOISTURE REGIME:
(subxeric) - submesic

ECOLOGICAL NUTRIENT REGIME:
submesotrophic - (mesotrophic)

DISTRIBUTION: uncommon in the ICHg3 because of history of disturbance; most such dry, poor sites presently occupied by the seral ecosystem association, ICHg3/08.

PHYSIOGRAPHIC FEATURES:
Slope position: upper slopes and ridge crests, some terraces and benches; generally moisture-shedding positions.
Slope range: level to moderately steep (0 - 45%+).
Surface shape: usually convex, occasionally straight or irregular.
Landforms: morainal (colluvial) veneers over bedrock; some morainal blankets; coarse textured glaciofluvial and fluvial deposits.

ICHg3/03 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: typically a dense canopy of small, short trees.

western hemlock	(*Tsuga heterophylla*)]	-dominant cover
lodgepole pine	(*Pinus contorta*)	-scattered in and above main canopy
[subalpine fir	(*Abies lasiocarpa*)]	)-poor growth, generally restricted to sub-canopy layers
[western redcedar	(*Thuja plicata*)]	)

Shrubs: a very poorly developed layer, sometimes absent; little advance regeneration.

[black huckleberry	(*Vaccinium membranaceum*)]	-scattered, low vigour
[false azalea	(*Menziesia ferruginea*)]	
[falsebox	(*Paxistima myrsinites*)]	
[prickly rose	(*Rosa acicularis*)]	
[Saskatoon	(*Amelanchier alnifolia*)]	-seral remnants, dying out

Herbs: a very poorly developed layer, occasionally absent.

[prince's pine	(*Chimaphila umbellata*)]	)-scattered individuals or small patches of low vigour
[one-sided wintergreen	(*Orthilia secunda*)]	)
[bunchberry	(*Cornus canadensis*)]	)
[green wintergreen	(*Pyrola chlorantha*)]	)
[twinflower	(*Linnaea borealis*)]	)
[rattlesnake plantain	(*Goodyera oblongifolia*)]	)
[round-leaved rein-orchid	(*Plantanthera orbiculata*)]	)

Moss layer: generally a well-developed solid carpet of feather mosses.

Hylocomium splendens
Pleurozium schreberi
[*Ptilium crista-castrensis*]
[*Rhytidiadelphus triquetrus*]
[*Dicranum polysetum*]

Remarks: The Dry hemlock-moss ecosystem association primarily represents submesic-to-subxeric ecosystems with a relatively poor nutrient status. The dominant visual features of this e.a. are the usually dense canopy of small trees and the nearly bare understory that often contains little more than a carpet of feather mosses. Hemlock dominates climax stands. Pine is its most frequent associate and tends to be the dominant cover in seral stands belonging to this association. Pine also appears to be the fastest growing tree in this unit. Small, suppressed cedar and subalpine fir are quite common below the main canopy but they rarely reach a co-dominant position in the stand. Spruce are very rare and have low vigour.

It may be difficult to differentiate this ecosystem association from the Zonal hemlock - moss e.a. (ICHg3/01) except by comparing *relative* tree productivity and the *relative* diversity and vigour of understory species. Both productivity and diversity are lower in the ICHg3/03. In this Dry hemlock - moss e.a., also, *Pleurozium schreberi* tends to be a dominant moss and herbs such as queen's cup and wild sarsaparilla are generally absent.

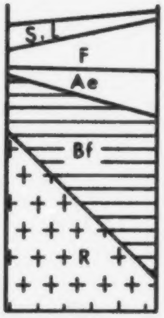
ICHg3/03(a) DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: LITHIC PHASE

SOILS: The major feature of soil profiles in the lithic phase is the presence of bedrock, often within 40 cm of the mineral surface. Such shallow mineral soils tend to be rapidly drained and relatively coarse textured. Yellowish brown (Bf) to brown (Bm), loamy sand, mineral horizons may or may not be overlain by a pale brown mineral horizon (Ae) that has undergone intense leaching. Organic materials are very thin, generally ranging from 3 to 5 cm in thickness.

Soil Classification: dominantly Orthic Humo-Ferric Podzols and Typic Folisols (these Folisols have more than 10 cm of organic soil horizons (L, F, and H) over bedrock).

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
S,L	- moss layer with discontinuous litter.
F	- slightly to moderately decomposed; brown organic materials; abundant fine, medium roots; abundant white and/or yellow mycelia.
Ae	- pale brown; loamy sand; few roots.
Bf	- yellowish-brown to brown; loamy sand to sandy loam; plentiful fine, medium, coarse roots; coarse fragment content often greater than 40%.
R	- bedrock.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.8
organic horizons - 3.0

Key Characteristics:

- thin accumulation of organic materials (less than 5 cm) suggests low capacity for insulation and retention of moisture.
- shallow soils; bedrock often within 40 cm of the mineral surface.
- soils rapidly drained, having low moisture- and nutrient-holding capacities.
- effective rooting generally to bedrock.

Comments: As with the dry hemlock outcrops and pine - lichen sites, the lithic phase of the Dry hemlock - moss ecosystem association is sensitive to logging activity, due to shallow soils and thin humus. Bedrock chemistry may strongly influence the nutrient status of such ecosystems, because there is good root penetration of the shallow soils.

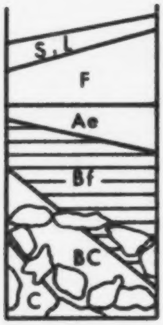
ICHg3/03(b) DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: COARSE TEXTURED PHASE

SOILS: Soil profiles of this phase have formed on coarse sand to sandy loam textured parent materials (fluvial, glaciofluvial, washed till). Brown (Bf) to yellowish brown (Bm) surface mineral horizons show a gradation to lighter yellowish brown sandy horizons with depth. The volume of gravels usually varies from 30 to 60%. Relatively thin (5-10 cm), matted organic layers have developed on these well-drained soils.

Soil Classification: Orthic Humo-Ferric Podzols and Orthic Dystric Brunisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- moderately decomposed organic horizon; dark brown; abundant fine, medium roots; common fungal mycelia; acidic.
Ae	- pale brown; loamy sand; few coarse roots.
Bf	- strong brown (Bf) to yellowish brown (Bm); sandy loam to loam; plentiful medium, coarse roots.
BC	- olive brown; loose; sands, loamy sands; few fine roots; high coarse fragment content (often greater than 40%).

Orthic Humo-Ferric Podzol

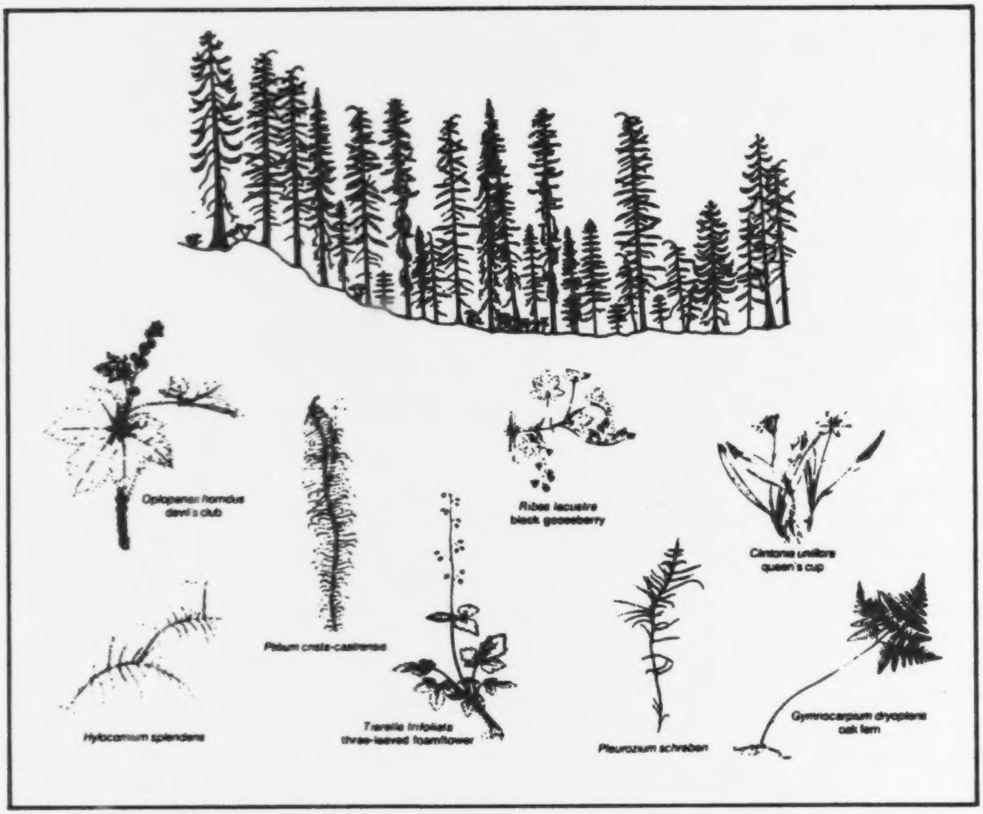
Average pH: mineral horizons - 4.9
organic horizons - 3.6

Key Characteristics:

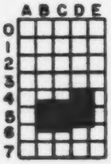
- surface organic layers, although relatively thin and acidic, are still important in retaining moisture and releasing nutrients.
- coarse textured, rapidly drained soils, particularly in subsurface mineral horizons.
- soils derived from fluvial, glaciofluvial, and washed morainal parent materials.
- effective rooting often deeper than 60 cm.

ICHg3: HAZELTON VARIANT

/04.1 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, HEMLOCK - CEDAR SUBASSOCIATION (232)


Oplopanax horridus
devil's club
Ptilium crista-castrensis
Ribes lacustre
black gooseberry
Clintonia uniflora
queen's cup
Hylocomium splendens
Tiarella trifoliata
three-leaved foamflower
Pleurozium schreberi
Gymnocarpium dryopteris
oak fern

ECOLOGICAL MOISTURE REGIME:
(mesic+) - subhygric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ECOLOGICAL NUTRIENT REGIME:
(mesotrophic) - permesotrophic

DISTRIBUTION: occurs throughout the ICHg3, but most common above major valley floors.

PHYSIOGRAPHIC FEATURES:

Slope position: primarily lower slopes, some mid-slopes, minor drainages; valley floors; positions receiving some seepage moisture.

Slope range: primarily gentle slopes; level to moderately steep (0 - 60%).

Surface shape: straight to slightly concave, (flat); rarely convex.

Landforms: morainal blankets, occasionally washed; fluvial over morainal deposits; glaciofluvial deposits.

ICHg3/04.1 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, HEMLOCK - CEDAR SUBASSOCIATION

VEGETATION:

Trees: most species have moderately good vigour.

western hemlock	(*Tsuga heterophylla*)	)-either one may be
western redcedar	(*Thuja plicata*)	) the dominant cover
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]	-scattered individuals in most stands; tallest tree
[paper birch	(*Betula papyrifera*)]	-common seral remnant, subcanopy layers

Shrubs: a moderately well-developed layer.

devil's club	(*Oplopanax horridus*)	-consistently present but not always dominant
black gooseberry	(*Ribes lacustre*)	-consistently present but inconspicuous
highbush-cranberry	(*Viburnum edule*)	
thimbleberry	(*Rubus parviflorus*)	
[huckleberries/blueberries	(*Vaccinium ovalifolium*, *V. membranaceum*)]	
[false azalea	(*Menziesia ferruginea*)]	

Herbs: moderately to well-developed layer; fairly diverse species composition.

oak fern	(*Gymnocarpium dryopteris*)	-characteristic dominant
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	)-good indicator) species
clasping twistedstalk	(*Streptopus amplexifolius*)	)
bunchberry	(*Cornus canadensis*)	)-consistently pres-
one-sided wintergreen	(*Orthilia secunda*)	) ent, but not good indicator species
[queen's cup	(*Clintonia uniflora*)]	)-important in
[false sarsaparilla	(*Aralia nudicaulis*)]	) some stands
[five-leaved bramble	(*Rubus pedatus*)]	)

Moss layer: a well-developed carpet of moss; feather mosses dominate.

Hylocomium splendens	
Ptilium crista-castrensis	
Pleurozium schreberi	
Rhytidiadelphus triquetrus	
[*Mnium* spp.]	-wettest microsites only

Remarks: This subassociation is considerably more productive than the Zonal hemlock-moss e.a., especially for cedar and spruce. Lodgepole pine is generally absent from the stand and subalpine fir is only a minor species.

Note that devil's club does not totally dominate the shrub layer in this ecosystem association although it is always present. The herb layer is lush compared with Zonal hemlock - moss ecosystems, but a carpet of mosses is still very visible. Lady fern (*Athyrium filix-femina*) and spiny wood fern (*Dryopteris assimilis*) are generally absent.

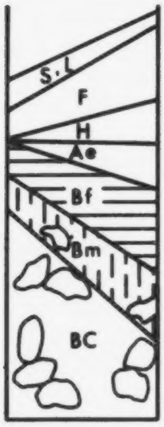
ICHg3/04.1 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, HEMLOCK - CEDAR SUBASSOCIATION

SOILS: A variety of soils exists within this subassociation; most lie in lower slope or receiving positions. Seepage is commonly found within 70 cm of the mineral surface; this indicates only short-term water saturation, since mottling rarely occurs. Dark yellowish brown (Bm) and yellowish to strong brown (Bf), loamy surface horizons are overlain by light brownish gray mineral horizons (Ae). Subsurface mineral horizons generally contain a high volume of coarse fragments, which aid in drainage. Organic materials are thin (4-6 cm) on fluvial or glaciofluvial landforms and thicker (7-20 cm) on morainal blankets.

Soil Classification: dominantly Orthic Humo-Ferric Podzols with minor Eutric Brunisols and Regosols.

Humus Form Classification: Orthimormoders; Orthivelomors (on active fluvial landforms).

Schematic Profile:



Horizon	Description
F	- variable depth; moderately decomposed, brownish organic horizons; contain fungal mycelia and/or insects; abundant fine, very fine roots.
H	- variable depth; well-decomposed organic horizon; dark brown to black; plentiful medium and coarse roots.
Ae	- light brownish gray; silt loam; few coarse roots; acidic.
Bf	- yellowish brown to strong brown; loamy; plentiful medium, fine roots.
Bm	- olive brown; loam to silt loam; plentiful medium and fine roots.
BC	- olive brown to yellowish brown; sandy to silt loam; seepage common below 60 cm; compacted to massive below 70 cm.

Orthic Humo-Ferric Podzol

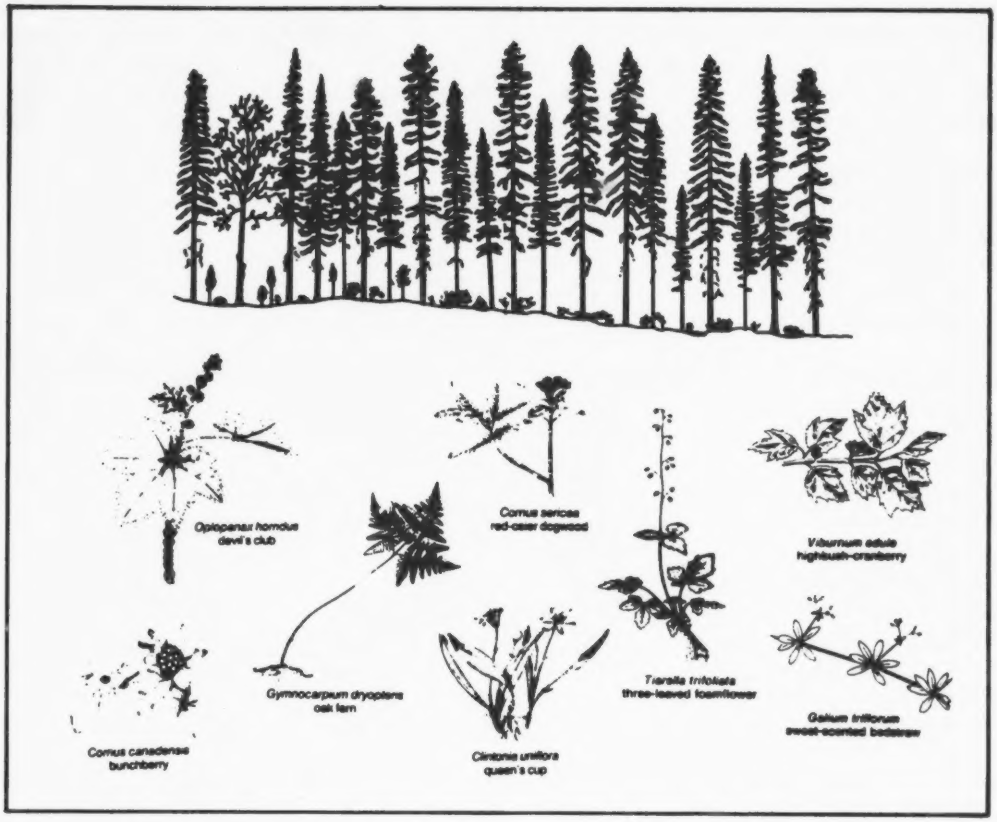
Average pH: mineral horizons - 5.0
organic horizons - 3.9

Key Characteristics:

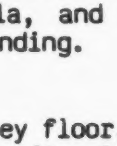
- high coarse fragment content, particularly in subsurface horizons of all landform types.
- found on lower slope or receiving positions where seepage waters commonly occur.
- common occurrence of compacted tills below 70 cm.
- silty upper horizons common; may cause frost heaving problems.

ICHg3: HAZELTON VARIANT

/04.2 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, SPRUCE SUBASSOCIATION (233)


Oplopanax horridus
devil's club
Cornus sericea
red-osier dogwood
Viburnum edule
highbush-cranberry
Gymnocarpium dryopteris
oak fern
Tiarella trifoliata
three-leaved foamflower
Galium triflorum
sweet-scented bedstraw
Cornus canadensis
bunchberry
Clintonia uniflora
queen's cup

ECOLOGICAL MOISTURE REGIME:
subhygric - (hygric)


A B C D E
0
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ECOLOGICAL NUTRIENT REGIME:
permesotrophic

DISTRIBUTION: found mainly at the northern and eastern extremities of the subzone where continental (sub-boreal) climatic influences are strong. Common in the Kispiox, Kitseguecla, and upper Kitwanga river valleys. Sites may be subject to cold air ponding.

PHYSIOGRAPHIC FEATURES:
Slope position: lower slope to valley floor; sites receiving seepage.
Slope range: level to gently sloping (0 - 15%).
Surface shape: flat - concave.
Landforms: fluvial, morainal, recent fluvial (alluvial) over glaciofluvial deposits.

ICHg3/04.2 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, SPRUCE SUBASSOCIATION

VEGETATION:

Trees: moderately large, good vigour; note general lack of western hemlock.

hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	
subalpine fir	(*Abies lasiocarpa*)	
[paper birch	(*Betula papyrifera*)]	-seral remnant

Shrubs: generally a well-developed layer.

devil's club	(*Oplopanax horridus*)
highbush-cranberry	(*Viburnum edule*)
red-osier dogwood	(*Cornus sericea*)
thimbleberry	(*Rubus parviflorus*)
black twinberry	(*Lonicera involucrata*)

Herbs: generally a well-developed layer; diverse species composition.

oak fern	(*Gymnocarpium dryopteris*)
bunchberry	(*Cornus canadensis*)
queen's cup	(*Clintonia uniflora*)
sweet-scented bedstraw	(*Galium triflorum*)
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)
red baneberry	(*Actaea rubra*)
trailing raspberry	(*Rubus pubescens*)
false Solomon's-seal	(*Smilacina racemosa*)
mountain sweet-cicely	(*Osmorhiza chilensis*)
false sarsaparilla	(*Aralia nudicaulis*)
star-flowered false Solomon's-seal	(*Smilacina stellata*)

Moss layer: poorly to moderately developed.

[*Ptilium crista-castrensis*]
[*Hylocomium splendens*]
[*Rhytidiadelphus triquetrus*]
[*Mnium* spp.]

Remarks: Like the Subalpine fir - spruce subassociation of the Zonal hemlock - moss ecosystem association (ICHg3/01.2), the Spruce subassociation (ICHg3/04.2) seems to occur where a localized "sub-boreal" climate develops on the valley floor. Hemlock is generally absent from the stand and subalpine fir dominates the advance regeneration.

Many stands belonging to this subassociation are still in a successional stage and contain some paper birch, aspen, or black cottonwood. There is a much greater diversity of shrubs and herbs than in hemlock-dominated Devil's club - oak fern - feather moss ecosystems, and the carpet of feather moss is poorly developed or lacking.

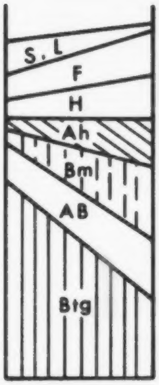
ICHg3/04.2 DEVIL'S CLUB - OAK FERN - FEATHER MOSS ECOSYSTEM ASSOCIATION, SPRUCE SUBASSOCIATION

SOILS: The profiles of this subassociation may represent slightly richer soils than those of the ICHg3/04.1. Seepage and mottling commonly occur within 60 cm of the soil surface, although well-drained coarse soils may also occur. Very dark brown to black surface mineral horizons (Ah) often reach depths of 4-14 cm and are underlain by yellowish brown to brown, loamy mineral horizons (Bm) that are well-drained. Subsurface mineral horizons may show signs of compaction and accumulation of clay (Bt), or they may contain well-drained sands.

Soil Classification: predominantly Orthic Eutric Brunisols and Gleyed Dark Gray Luvisols.

Humus Form Classification: Amphileptomoders; Amphimormoders.

Schematic Profile:



Horizon	Description
F	- brown; organic horizon with evidence of fungal and/or insect activity; abundant fine, medium roots.
H	- well-decomposed; black organic horizon; abundant medium, coarse roots.
Ah	- very dark brown; silt loam; granular; abundant fine, medium, coarse roots.
Bm	- dark yellowish brown to brown; loamy; plentiful fine, medium roots; moist to wet.
AB	- grayish brown; sandy to clay loam; seepage may occur; few fine roots.
(Btg)	- grayish-brown; sandy to clay; mottles common; clay skins on ped faces; high coarse fragment content (in coarse soils only).

Orthic Eutric Brunisol
(Gleyed Dark Gray Luvisol)

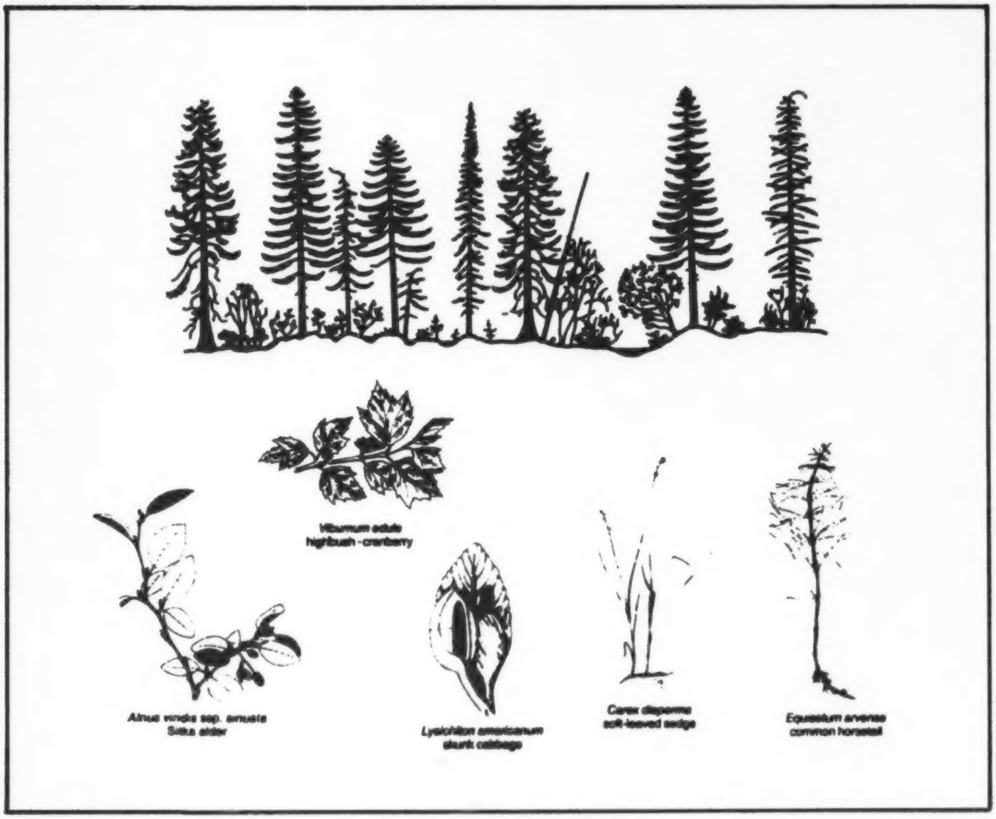
Average pH: mineral horizons - 5.2
organic horizons - 4.0

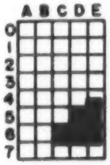
Key Characteristics:

- moist to wet soils, often receiving seepage.
- soils are either moderately well to poorly drained on morainal blankets or imperfectly to well-drained on fluvial deposits.
- common dark brown surface mineral horizons (Ah) showing an accumulation of organic matter, which improves water and nutrient retention.
- organic horizons are generally between 5 and 10 cm thick and are relatively nutrient-rich, with increased insect activity.

ICHg3: HAZELTON VARIANT

/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION (234)


Viburnum edule
highbush - cranberry
Alnus viridis ssp. sinuata
Sitka alder
Lysichiton americanum
skunk cabbage
Carex disperma
soft-leaved sedge
Equisetum arvense
common horsetail



ECOLOGICAL MOISTURE REGIME:
hygric (±)

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - eutrophic

DISTRIBUTION: found in small pockets throughout most of the ICHg3; some larger stands on major valley floors.

PHYSIOGRAPHIC FEATURES:
Slope position: toe slopes and valley floors, gullies and drainage channels; sites receiving abundant seepage.
Slope range: level to gently sloping (0 - 10%).
Surface shape: irregularly flat or straight, occasionally concave.
Landforms: primarily fluvial deposits; also, washed morainal and (lacustrine) deposits.

ICHg3/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: generally large, widely spaced.

hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	-largest tree
western redcedar	(*Thuja plicata*)	
western hemlock	(*Tsuga heterophylla*)	-generally a subcanopy tree
[black cottonwood	(*Populus balsamifera* ssp. *trichocarpa*)]	
[subalpine fir	(*Abies lasiocarpa*)]	-mainly in eastern sections

Shrubs: a well-developed layer, especially in stand openings.

devil's club	(*Oplopanax horridus*)	-characteristic dominant
black gooseberry	(*Ribes lacustre*)	
black twinberry	(*Lonicera involucrata*)	)-most abundant in
highbush-cranberry	(*Viburnum edule*)	) stand openings
thimbleberry	(*Rubus parviflorus*)	)
red-osier dogwood	(*Cornus sericea*)	)
currants	(*Ribes* spp.)	)

Herbs: a well-developed layer; diverse species composition.

lady fern	(*Athyrium filix-femina*)	-dominant on the richest sites
oak fern	(*Gymnocarpium dryopteris*)	
spiny wood fern	(*Dryopteris assimilis*)	
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
clasping twistedstalk	(*Streptopus amplexifolius*)	
enchanter's nightshade	(*Circaea alpina*)	
sweet-scented bedstraw	(*Galium triflorum*)	
red baneberry	(*Actaea rubra*)	
common mitrewort	(*Mitella nuda*)	
trailing raspberry	(*Rubus pubescens*)	
horsetails	(*Equisetum arvense*, *E. pratense*, *E. sylvaticum*)	-on wettest sites

Moss layer: poorly to moderately well-developed; feather mosses restricted to raised hummocks and decaying wood.

Mnium spp.	-dominant
[*Rhytidiadelphus triquetrus*]	
[*Brachythecium* spp.]	

Remarks: This is a productive ecosystem association for most tree species. Spruce and cedar grow very well, but hemlock seems to be confined to elevated hummocks or decaying wood and does not reach the size of the other species. Many of these ecosystem associations have been partially logged or are in a seral stage. Paper birch and black cottonwood are major components of many younger stands and light-demanding shrub species dominate over devil's club.

Note the absence of Vaccinium spp. except on decaying wood and raised mounds.

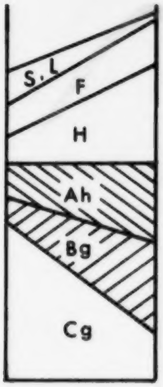
ICHg3/05 DEVIL'S CLUB - FERN - LEAFY MOSS ECOSYSTEM ASSOCIATION

SOILS: Soils in these receiving sites are characterized by high water tables and mottling close to the mineral surface. Deep, well to moderately well-decomposed organic layers may reach depths up to 40 cm. Dark brown to black surface mineral horizons (Ah) are common in those profiles sampled. These dark coloured horizons are underlain by brown to grayish mineral horizons that have abundant mottles, and range from sandy loam to clay loam texture. Seepage waters are commonly found in subsurface horizons.

*Soil Classification: Orthic Humic Gleysols and Gleyed subgroups of Luvisols and Brunisols.

Humus Form Classification: Amphihemihumimors; Amphimormoders.

Schematic Profile:



Horizon	Description
F	- slightly decomposed; light brown; well-aerated; abundant very fine, fine roots; common white fungal mycelia and/or insects.
H	- well-decomposed; moist to wet; dark brown to black; massive to blocky structure.
Ah	- very dark brown; silty clay loam; granular to massive; abundant medium, coarse roots; generally greater than 10 cm thick.
Bg	- grayish-brown; moist to wet; clay loam to sandy clay; common mottles; angular to massive; few to common clay skins; few to plentiful fine roots.
Cg	- dark gray; clay loam; many mottles; massive structure; few pores; few roots; few coarse fragments.

Orthic Humic Gleysol

*Average pH: mineral horizons - 5.7
organic horizons - 5.2

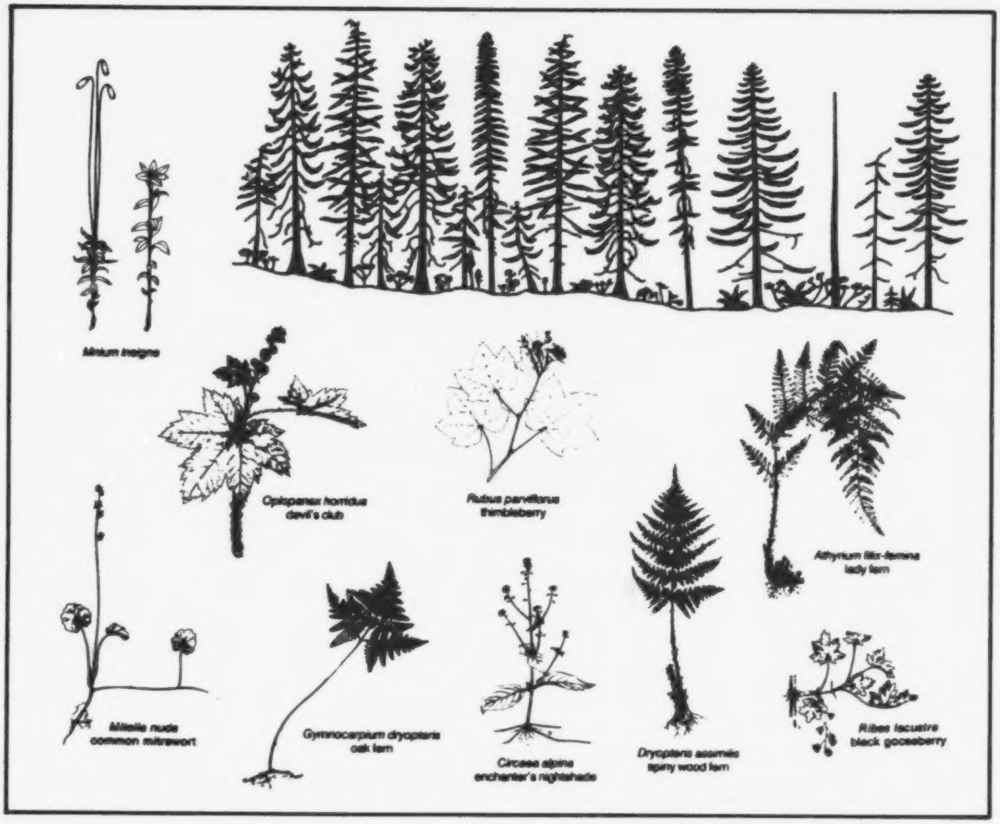
Key Characteristics:

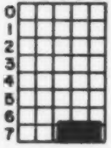
- thick, well-decomposed organic layers on toe slopes; thinner organic horizons on steeper wet slopes.
- seepage and/or water tables close to mineral surface.
- prominent mottles close to mineral surface.
- fine textured, wet, subsurface mineral horizons (Bg, Cg) may be compact and root-restricting.
- dark brown surface mineral horizons (Ah) support abundant rooting.
- rooting depth shallow, generally less than 45 cm.

*NOTE: very limited sampling of this ecosystem association.

ICHg3: HAZELTON VARIANT

/06 HORSETAIL - (SKUNK CABBAGE) SWAMP ECOSYSTEM ASSOCIATION (235)


Mnium insigne
Oplopanax horridus
devil's club
Rubus parviflorus
thimbleberry
Athyrium filix-femina
lady fern
Mitella nuda
common mitrewort
Gymnocarpium dryopteris
oak fern
Circaea alpina
enchanter's nightshade
Dryopteris assimilis
spiny wood fern
Ribes lacustre
black gooseberry


A
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ECOLOGICAL MOISTURE REGIME:
(hygric+) - subhydric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - eutrophic

DISTRIBUTION: found throughout the ICHg3, but neither common nor covering large areas; mainly at low elevations in major valleys.

PHYSIOGRAPHIC FEATURES:
Slope position: slope bases, valley floors, depressions in benches or terraces, positions collecting moisture.
Slope range: level to very gently sloping (0 - 2%).
Surface shape: flat to slightly concave; usually hummocky.
Landforms: organic veneers over fluvial, lacustrine, and washed morainal deposits.

ICHg3/06 HORSETAIL - (SKUNK CABBAGE) SWAMP ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: small to moderately large; canopy irregular, many openings.

hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)	
western redcedar	(*Thuja plicata*)	
subalpine fir	(*Abies lasiocarpa*)	
[western hemlock	(*Tsuga heterophylla*)]	-subcanopy layers

Shrubs: irregular cover, generally well-developed in stand openings.

Sitka alder	(*Alnus viridis* ssp. *sinuata*)	
black twinberry	(*Lonicera involucrata*)	
highbush-cranberry	(*Viburnum edule*)	
red-osier dogwood	(*Cornus sericea*)	
[false azalea	(*Menziesia ferruginea*)]	)-prominent on
[oval-leaved blueberry	(*Vaccinium ovalifolium*)]	) decaying wood and
		) elevated mounds
[devil's club	(*Oplopanax horridus*)]	
[hardhack	(*Spiraea douglasii*)]	

Herbs: a well-developed layer; diverse species composition.

horsetails	(*Equisetum arvense*, *E. pratense*, *E. sylvaticum*)	-characteristic herbs
oak fern	(*Gymnocarpium dryopteris*)	
lady fern	(*Athyrium filix-femina*)	
soft-leaved sedge	(*Carex disperma*)	-good indicator species
creeping snowberry	(*Gaultheria hispidula*)	
trailing raspberry	(*Rubus pubescens*)	
foamflowers	(*Tiarella trifoliata*, *T. unifoliata*)	
[skunk cabbage	(*Lysichiton americanum*)	-important on some
[marsh violet	(*Viola palustris*)]	sites

Moss layer: generally well-developed; diverse species composition.

Mnium spp.		
Rhytidiadelphus triquetrus		
Ptilium crista-castrensis		)-restricted to
Pleurozium schreberi		) elevated mounds
Hylocomium splendens		) and decaying wood
[*Sphagnum* spp.]		)-good indicator
[thalloid liverworts	(*Marchantia polymorpha*, *Pellia neesiana*)]	) species

Remarks: Small patches of this ecosystem association are scattered throughout the ICHg3, but are only of minor importance for forest management. Tree productivity varies from extremely poor to quite good depending on nutrient availability and the degree of soil aeration. Spruce seems to be the best growing tree on most sites.

Skunk cabbage is an excellent indicator species when present, but it is generally lacking towards the eastern parts of the variant. Horsetail and soft-leaved sedge are usually more reliable indicators. Some of the best examples of this ecosystem association resemble the Devil's club - fern - leafy moss e.a. (ICHg3/05), but they generally have a low cover of devil's club and abundant cover of the indicator species mentioned above as well as some *Sphagnum* moss.

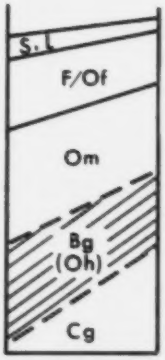
ICHg3/06 HORSETAIL - (SKUNK CABBAGE) - SWAMP ECOSYSTEM ASSOCIATION

SOILS: Soils have formed in poorly drained depressions and are dominantly organic. Excessive water often limits decomposition of these materials. Soils tend to be poorly aerated and saturated for most of the growing season. Moderately decomposed, mucky organic horizons (Om) often dominate the upper 30+ cm of the profile and may reach 1 m in depth. Gleyed, bluish to olive gray, sometimes brown-stained mineral horizons may be found at depth.

*Soil Classification: Terric & Orthic Mesisols and Orthic Gleysols.

Humus Form Classification: Orthihistomors; Orthihistomoders.

Schematic Profile:



Horizon	Description
F/Of	- freely to poorly drained; partially decomposed; wet to very moist; light brown; massive; common fine, medium roots.
Om	- poorly drained; moderately decomposed; wet; dark brown; massive; few medium, coarse roots; variable depth.
Bg (Oh)	- poorly drained; well-decomposed organic and/or mineral material; wet; massive; gritty; mushy.
Cg	- lower mineral horizons; bluish-gray to dark brown; loam to sandy clay; massive, compact; prominent mottles; water table and/or seepage present.

Terric Mesisol

Average pH: mineral horizons - no data available
organic horizons - no data available

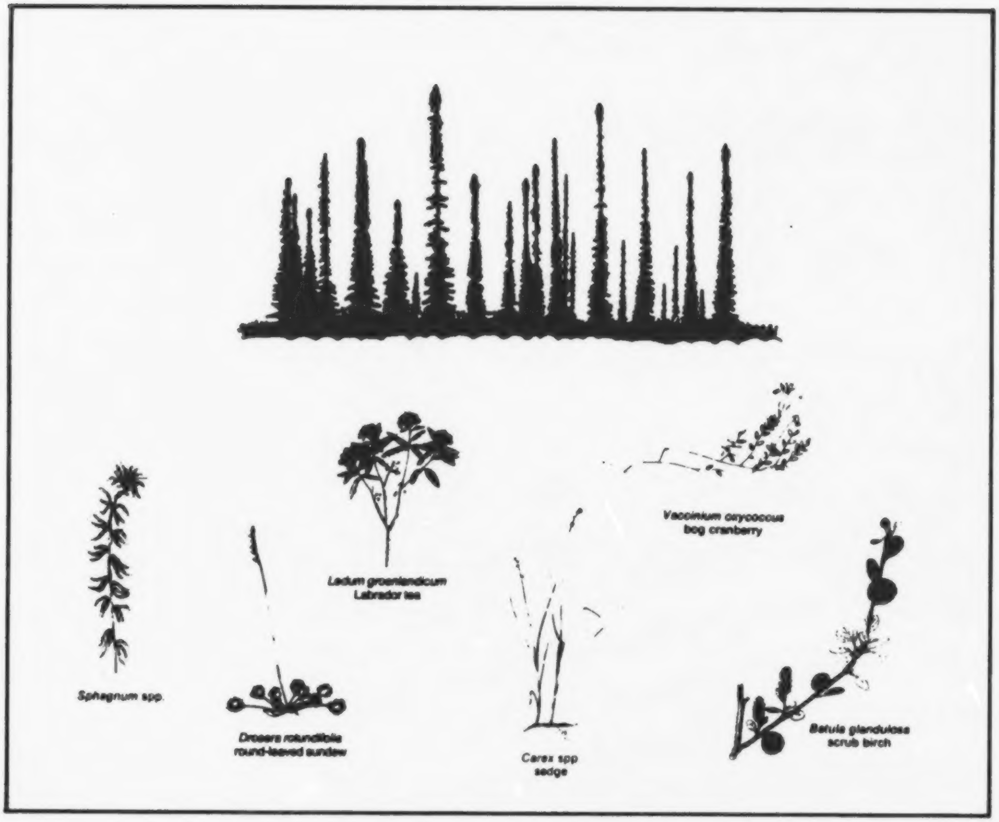
Key Characteristics:

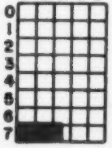
- thick, wet surface organic layers up to 1 m in depth.
- water table often within 30 cm of the top of the organic horizons.
- the freely drained organic layers that often occur on raised hummocks and decaying wood, tend to provide the best rooting medium.
- subsurface mineral horizons are compacted and lack aeration pores necessary for rooting.

* Note: limited sampling of this ecosystem association.

ICHg3: HAZELTON VARIANT

/07 BLACK SPRUCE - PEAT MOSS ECOSYSTEMS (230)


Vaccinium oxycoccus
bog cranberry
Ledum groenlandicum
Labrador tea
Sphagnum spp.
Drosera rotundifolia
round-leaved sundew
Carex spp
sedge
Betula glandulosa
scrub birch


A B C D E
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ECOLOGICAL MOISTURE REGIME:
subhydric

ECOLOGICAL NUTRIENT REGIME:
oligotrophic - mesotrophic

DISTRIBUTION: at low elevations in the main valleys of the ICHg3; not common, restricted to poorly drained frost pockets.

PHYSIOGRAPHIC FEATURES:
Slope position: valley floors, depressions.
Slope range: level (0 - 2%).
Surface shape: flat, many small hummocks.
Landforms: thick organic deposits.

ICHg3/07 BLACK SPRUCE - PEAT MOSS ECOSYSTEMS

VEGETATION:

Trees: small, stunted, irregular in height; variable stocking.

black spruce	(*Picea mariana*)	
[lodgepole pine	(*Pinus contorta*)]	-very poor vigour

Shrubs: moderately to well-developed layer, clumped.

willows	(*Salix* spp.)
scrub birch	(*Betula glandulosa*)
Labrador tea	(*Ledum groenlandicum*)
hardhack	(*Spiraea douglasii*)
[bog-laurel	(*Kalmia microphylla*)]

Herbs: well-developed, variable in composition.

sedges	(*Carex* spp.)
swamp horsetail	(*Equisetum fluviatile*)
buckbean	(*Menyanthes trifoliata*)
[creeping-snowberry	(*Gaultheria hispidula*)]
[bog rosemary	(*Andromeda polifolia*)]
[bog cranberry	(*Vaccinium oxycoccos*)]
[round-leaved sundew	(*Drosera rotundifolia*)]
[marsh cinquefoil	(*Potentilla palustris*)]
[white bog-orchid	(*Plantanthera dilatata*)]
[cloudberry	(*Rubus chamaemorus*)]

Moss layer: a solid hummocky mat of peat moss.

Sphagnum spp.	-dominant cover
Tomenthypnum nitens	)-characteristic
Aulacomnium palustre	) mosses
[*Calliergon* sp.]	)
[*Hylocomium splendens*]	)-on well-drained
[*Pleurozium schreberi*]	) mounds only

Remarks: Black spruce - peat moss ecosystems are distinctive and unmistakably different from any other ecosystem unit described in this guide. Within the ICHg subzone, they are unique to the g3 variant but occur widely further inland in the Sub-Boreal Spruce Zone (SBS). These ecosystems are typically found in depressional frost pockets where an organic mat has grown out over a pond or lakeshore.

We do not consider black spruce - peat moss ecosystems as a single ecosystem association because they encompass a wide variety of wetland types. Wetlands ranging from open untreed bogs to closed black spruce swamps, and from very acidic bogs to almost alkaline fens are included. These differences are ecologically significant but are of little importance for silviculture and other aspects of forest management. All of the ecosystems included here are unsuitable for commercial timber production.

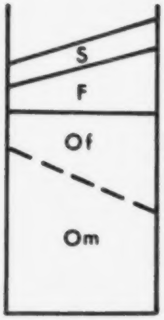
ICHg3/07 BLACK SPRUCE - PEAT MOSS ECOSYSTEMS

SOILS: As with the Horsetail - swamp ecosystem association, soils of the Black spruce - peat moss ecosystems are organic and saturated with water for most or all of the growing season. However, moisture is always excessive in bog soils, with permanent water tables often occurring within 15 cm of the uppermost organic layer. Poorly aerated, organic deposits usually extend to depths greater than 1 m, and rooting is generally restricted to elevated hummocks.

Soil Classification: Mesic Fibrisols; Terric Mesisols.

Humus Form Classification: Orthihistomors; Orthihistomoders.

Schematic Profile:



Horizon	Description
S	- thick *Sphagnum* moss.
F	- wet; well-aerated; slightly decomposed; brown; few to abundant medium and coarse roots; few mycelia.
Of	- wet; poorly aerated; slightly decomposed sedges, reeds and *Sphagnum*; original structures readily discernible; very dark gray.
Om	- wet; poorly aerated; moderately decomposed; original structures barely discernible; very dark brown.

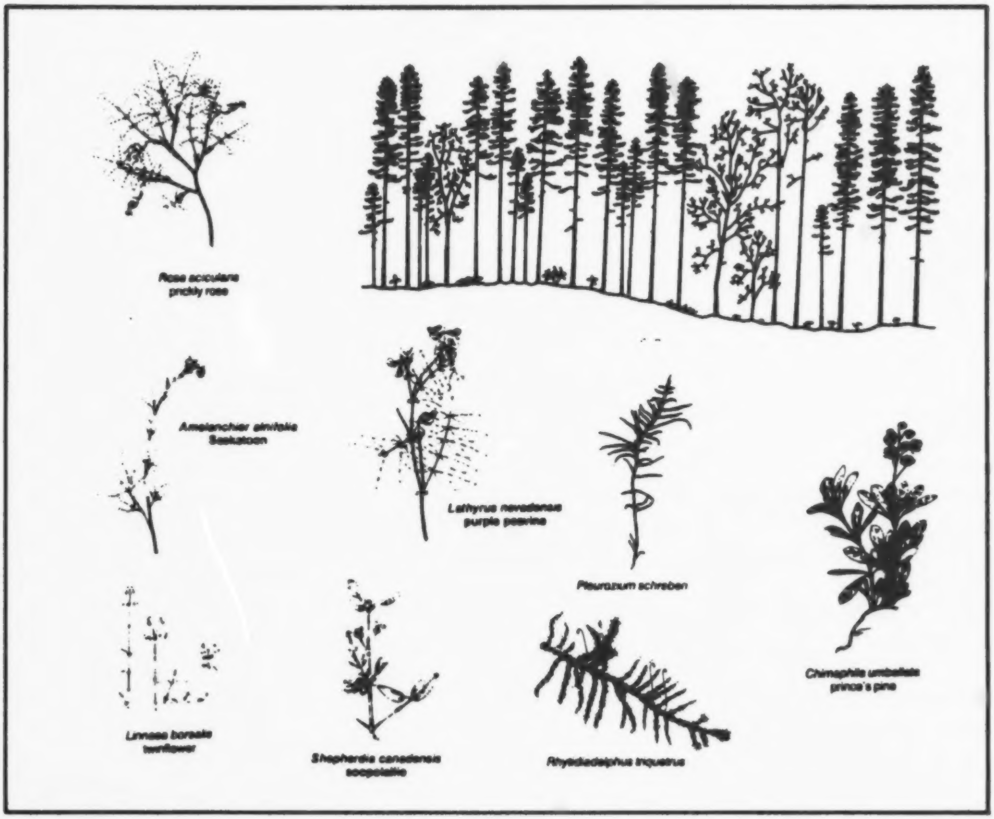
Mesic Fibrisol

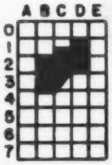
Average pH: mineral horizons - (no samples)
organic horizons - 5.2

Comments: Limited vegetative rooting as a result of permanent cold standing water within 30 cm (and often 15 cm) of the uppermost organic horizon. Outer boundaries of bog depressions may have better aerated organic horizons and may support deeper rooting.

ICHg3: HAZELTON VARIANT

/08 PINE - SOOPOLALLIE SERAL ECOSYSTEM ASSOCIATION (231)


Rosa acicularis
prickly rose
Amelanchier alnifolia
Saskatoon
Lathyrus nevadensis
purple peavine
Pleurozium schreberi
Chimaphila umbellata
prince's pine
Linnaea borealis
twinflower
Shepherdia canadensis
soopolallie
Rhytidiadelphus triquetrus



ECOLOGICAL MOISTURE REGIME:
subxeric - (submesic)

ECOLOGICAL NUTRIENT REGIME:
submesotrophic - (permesotrophic)

DISTRIBUTION: common along major river valleys in the ICHg3.

PHYSIOGRAPHIC FEATURES:
Slope position: river terraces, benches, ridges and upper slopes; shedding positions.
Slope range: level to gently sloping (0 - 15%).
Surface shape: flat, straight to convex.
Landforms: primarily glaciofluvial terraces; some eskers and kames; morainal blankets and shallow veneers over bedrock.

ICHg3/08 PINE - SOOPOLALLIE SERAL ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: somewhat larger and taller than in ICHg3/02; stands often dense.

lodgepole pine	(*Pinus contorta*)	
[trembling aspen	(*Populus tremuloides*)]	
[paper birch	(*Betula papyrifera*)]	-scattered below main canopy

Shrubs: generally a moderately developed layer; most species have low vigour.

soopolallie	(*Shepherdia canadensis*)	-characteristic dominant shrub
Saskatoon	(*Amelanchier alnifolia*)	
prickly rose	(*Rosa acicularis*)	
thimbleberry	(*Rubus parviflorus*)	
black huckleberry	(*Vaccinium membranaceum*)	

Herbs: a moderately diverse and well-developed layer; contains a mixture of dry and mesic site indicator species.

twinflower	(*Linnaea borealis*)
bunchberry	(*Cornus canadensis*)
rattlesnake plantain	(*Goodyera oblongifolia*)
prince's pine	(*Chimaphila umbellata*)
purple peavine	(*Lathyrus nevadensis*)
kinnikinnick	(*Arctostaphylos uva-ursi*)
dwarf blueberry	(*Vaccinium caespitosum*)
ricegrasses	(*Oryzopsis asperifolia*, *O. pungens*)
wild strawberry	(*Fragaria virginiana*)
one-sided wintergreen	(*Orthilia secunda*)
heart-leaved arnica	(*Arnica cordifolia*)

Moss layer: a well-developed moss carpet. Lichens other than *Peltigera* spp. are generally absent.

Pleurozium schreberi
Rhytidiadelphus triquetrus
[*Ptilium crista-castrensis*]
[*Hylocomium splendens*]

Remarks: This seral ecosystem association is slightly moister and more productive than the Pine - lichen e.a. (ICHg3/02) but it is still quite droughty. Growth of pine on these sites is marginal for commercial timber production. Aspen and birch are common minor components of the tree cover and western hemlock dominates the advance regeneration. Sites included in this unit are generally too dry to support growth of spruce or subalpine fir. If these ecosystems were allowed to reach climax, they would develop into the Dry hemlock - moss e.a. (ICHg3/03), but under natural conditions the succession would probably be interrupted by fire.

Abundance of species such as thimbleberry, bunchberry, one-sided wintergreen, Rhytidiadelphus triquetrus, Hylocomium splendens, and Ptilium crista-castrensis, and the lack of Cladina and Cladonia lichens on the forest floor differentiate this seral ecosystem association from the Pine - lichen e.a.

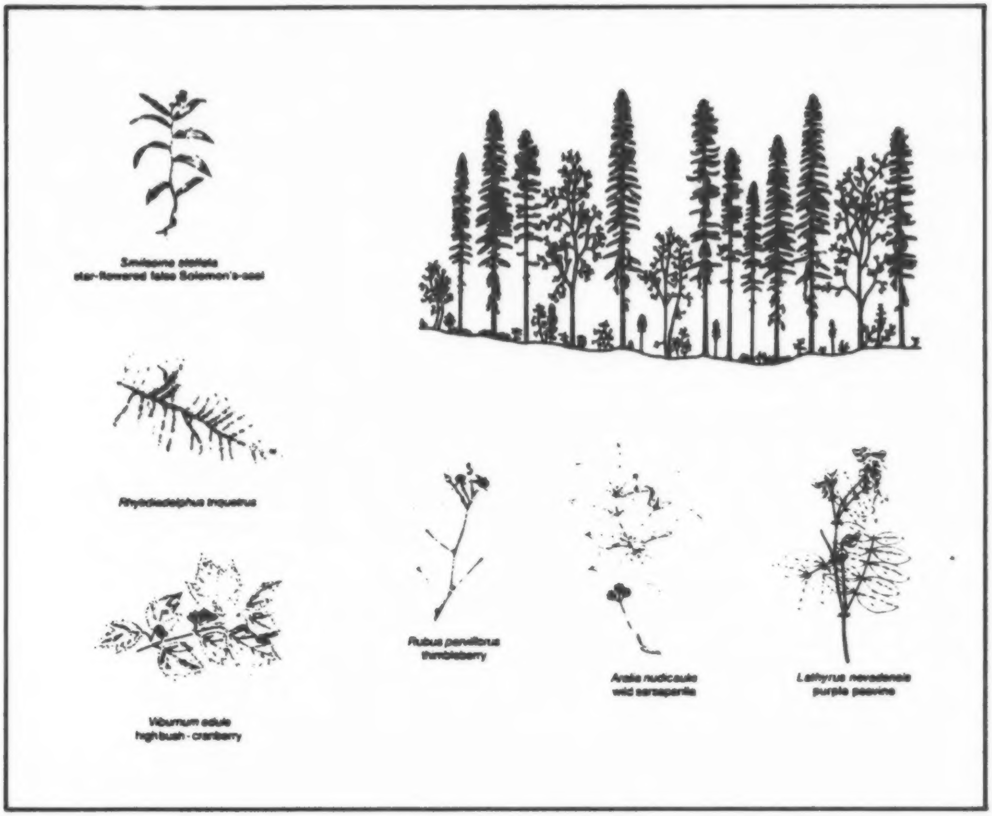
ICHg3/08 PINE - SOOPOLALLIE SERAL ECOSYSTEM ASSOCIATION

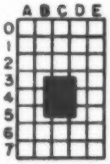
SOILS:

Refer to the soils page for the Dry hemlock - moss ecosystem association (ICHg3/03).

ICHg3: HAZELTON VARIANT

/09 SPRUCE - PINE - SHRUB SERAL ECOSYSTEM ASSOCIATION (229, 231)


Smilacina stellata
star-flowered false Solomon's-seal
Rhytidiadelphus triquetrus
Viburnum edule
high bush - cranberry
Rubus parviflorus
thimbleberry
Aralia nudicaulis
wild sarsaparilla
Lathyrus nevadensis
purple peavine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ECOLOGICAL MOISTURE REGIME:
(submesic) - mesic - (subhygric)

ECOLOGICAL NUTRIENT REGIME:
mesotrophic

DISTRIBUTION: widespread at low elevations throughout the ICHg3, but especially common in eastern portions of the variant.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floors and river terraces; middle to lower slopes in rolling terrain.

Slope range: level to moderately sloping (0 - 25%+).

Surface shape: variable; flat or straight, slightly concave or convex.

Landforms: glaciofluvial and morainal deposits; rarely with a colluvial, lacustrine, or recent fluvial capping.

ICHg3/09 SPRUCE - PINE - SHRUB SERAL ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: composition variable; dominantly coniferous cover.

hybrid spruce	(Picea glauca x sitchensis ? x engelmannii)	
lodgepole pine	(Pinus contorta)	
[paper birch	(Betula papyrifera)]	-major subcanopy species
[trembling aspen	(Populus tremuloides)]	-sporadic
[subalpine fir	(Abies lasiocarpa)]	-dominates advance regeneration

Shrubs: a well to moderately well-developed layer.

thimbleberry	(Rubus parviflorus)	-usually dominant
highbush-cranberry	(Viburnum edule)	
red-osier dogwood	(Cornus sericea)	
prickly rose	(Rosa acicularis)	
black twinberry	(Lonicera involucrata)	
common-snowberry	(Symphoricarpos albus)	

Herbs: generally a diverse and well-developed layer.

wild sarsaparilla	(Aralia nudicaulis)	)-seral herbs
purple peavine	(Lathyrus nevadensis)	) dominate
star-flowered false Solomon's-seal	(Smilacina stellata)	)
false Solomon's-seal	(Smilacina racemosa)	
bunchberry	(Cornus canadensis)	
queen's cup	(Clintonia uniflora)	
trailing raspberry	(Rubus pubescens)	
one-sided wintergreen	(Orthilia secunda)	
[northern bedstraw	(Galium boreale)]	
[pink wintergreen	(Pyrola asarifolia)]	
[mountain sweet-cicely	(Osmorhiza chilensis)]	
[palmate colt's-foot	(Petasites palmatus)]	
[heart-leaved arnica	(Arnica cordifolia)]	

Moss layer: well to moderately developed carpet of moss.

Rhytidiadelphus triquetrus	
Ptilium crista-castrensis]	
Pleurozium schreberi	
Hylocomium splendens	
[Mnium spp.]	-on moister sites

Remarks: The spruce - pine - shrub seral ecosystem association includes successional stands of medium to good productivity. They are dominated by spruce in association with pine and birch. Aspen occurs only occasionally. Subalpine fir, although it dominates the advance regeneration, is rarely a significant component of the tree canopy until later successional stages.

Many of these ecosystems will evolve into a Subalpine fir - spruce subassociation of the Zonal hemlock - moss e.a. (ICHg3/01.2), while others would eventually become dominated by hemlock (ICHg3/01.1) if succession were allowed to proceed.

Note the absence of big huckleberry (Vaccinium membranaceum) and the predominance of seral herbs and Rhytidiadelphus triquetrus moss.

ICHg3/09 SPRUCE - PINE - SHRUB SERAL ECOSYSTEM ASSOCIATION

SOILS: The Spruce - pine - shrub seral ecosystem association includes a wide range of soil and environmental conditions. At present we recognize two phases of this seral ecosystem association based on soil characteristics: /09(a) coarse textured phase; /09(b) fine textured phase.

The coarse textured phase tends to be drier and poorer in nutrients than the fine textured phase, and thus has poorer growth of trees and understory vegetation. Drier-site indicator species may predominate on the coarse textured phase while moist-site plants like oak fern may be found on some examples of the finer textured phase, but the differences in vegetation are usually subtle and cannot be relied upon to differentiate the two soil phases.

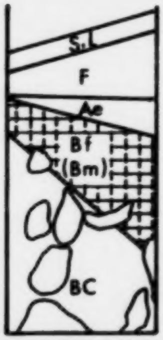
ICHg3/09(a) COARSE TEXTURED PHASE

SOILS: These soils have developed mainly from glaciofluvial and fluvial parent materials that are coarse in texture, but slightly less acidic (higher pH) than glaciofluvial landforms of other dry, coarse textured ecosystem associations. Soils are characterized by sandy loam to loam surface mineral horizons. The redness of the horizons varies depending upon the degree of podzolization. Profiles with yellowish brown Bm horizons lacking the redder Bf horizons show Brunisolic development. Commonly, a thin light brownish gray leached horizon (Ae) overlies these B horizons. Surface organic materials range in depth from 5 to 10 cm, with moderately decomposed F horizons dominating.

Soil Classification: Orthic Humo-Ferric Podzols and Orthic Dystric Brunisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Orthic Humo-Ferric Podzol
(Orthic Dystric Brunisol)

Horizon	Description
F	- moist; dark brown; moderately decomposed; contains abundant fungal mycelia.
Ae	- light brownish gray; loamy; coarse roots; acidic.
Bf (Bm)	- strong brown to yellowish brown; sandy to loamy; friable; plentiful fine, medium; few coarse roots.
BC	- olive brown; sandy to gravelly; few fine, medium roots; high coarse fragment volume.

Average pH: mineral horizons - 5.1
organic horizons - 4.2

Key Characteristics:
- well to rapidly drained coarse textured soils.
- deep effective rooting (often more than 70 cm).
- relatively thin, acidic organic materials ranging from 5 to 10 cm in thickness are important in moisture retention in such coarse textured soils.

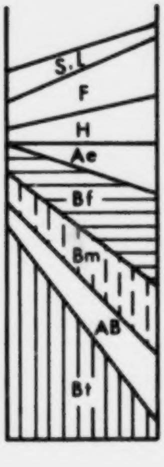
ICHg3/09(b) FINE TEXTURED PHASE

SOILS: This phase includes those soils which are finer in texture, having formed mostly on morainal blankets. Within these profiles little or no washing out of fines has occurred. Surface mineral horizons are generally dark yellowish brown to reddish-brown and have sandy loam to silt loam textures. Deeper within the profile, the clay content increases and clay skins are often found on ped faces, and/or in pores as evidence of clay movement. Mottling is also common in subsurface mineral horizons, another difference between the fine and coarse textured phases. Surface organic horizons generally range from 5 to 10 cm, and are slightly less acidic (higher pH) than those organic materials found on the coarse textured soils.

Soil Classification: dominantly (Gleyed) Brunisolic Gray Luvisols; minor Orthic Eutric Brunisols and Podzolic Gray Luvisols.

Humus Form Classification: Orthimormoders; Orthihemimors.

Schematic Profile:



Horizon	Description
F	- partially decomposed brown to dark brown organic horizon; structureless to non-compact matted; abundant very fine, fine, medium roots; evidence of fungal mycelia and/or zoogenous activity.
Ae	- light brownish gray; sandy loam; few roots; acidic.
(Bf) Bm	- reddish brown to strong brown; fine sands to loams; friable; moist; plentiful to abundant medium, coarse roots.
Bt	- light brownish gray to dark gray; silt loam to clay loam; mottles may be present; angular blocky structure; few to plentiful fine, medium roots; clay films common in lower horizons.

Gleyed Brunisolic Gray Luvisol

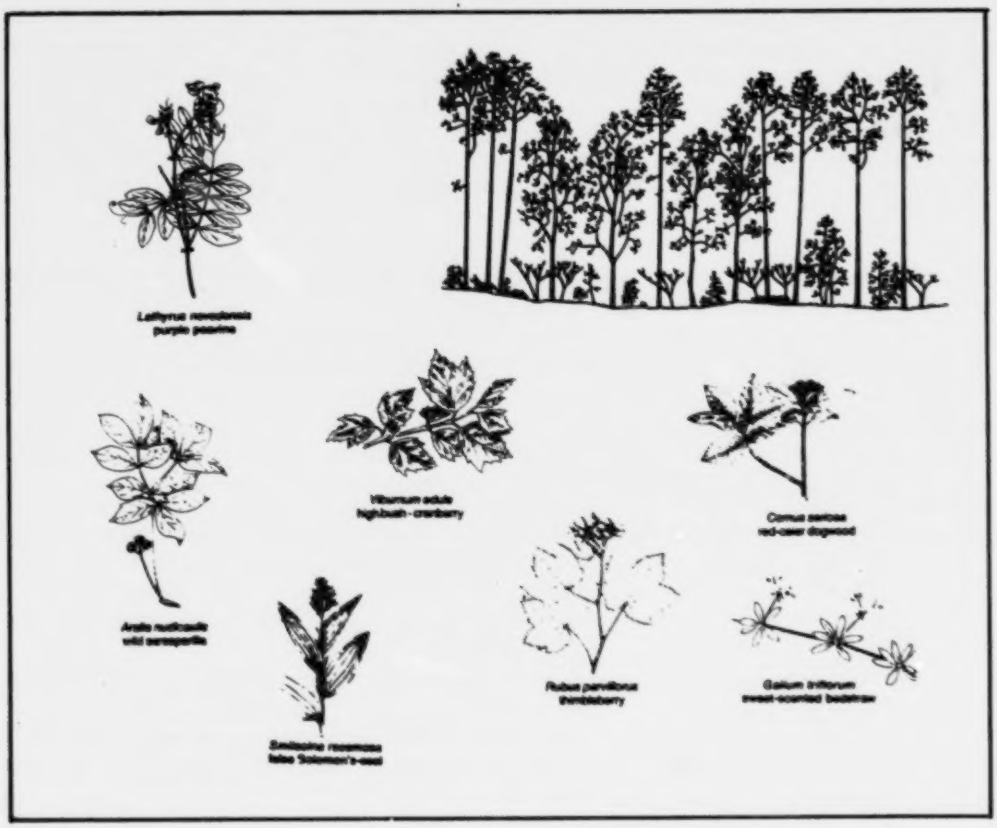
Average pH: mineral horizons - 5.1
organic horizons - 4.4

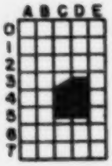
Key Characteristics:

- fine textured soils, particularly in subsurface mineral soil horizons (AB, Btg, Cg).
- greater ability to hold on to moisture and nutrients than coarse phase.
- massive to angular blocky Bt horizon with clay skins and common mottling.
- effective rooting varies, depending on soil structure of lower clay horizons and depth of water table (25 - 90 cm).

ICHg3: HAZELTON VARIANT

/10 ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION (236)


Lathyrus nevadensis
purple peavine
Viburnum edule
highbush-cranberry
Cornus sericea
red-osier dogwood
Aralia nudicaulis
wild sarsaparilla
Rubus parviflorus
thimbleberry
Galium triflorum
sweet-scented bedstraw
Smilacina racemosa
false Solomon's-seal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ECOLOGICAL MOISTURE REGIME:
(submesic) - mesic - subhygric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic

DISTRIBUTION: widespread at low elevations throughout the ICHg3; very common.

PHYSIOGRAPHIC FEATURES:
Slope position: middle to lower slopes in rolling terrain.
Slope range: level to moderately sloping (0 - 25%+); usually gently sloping.
Surface shape: straight or flat, rarely slightly convex or concave.
Landforms: morainal blankets, occasionally washed.

ICHg3/10 ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: dominantly or completely deciduous.

trembling aspen	(*Populus tremuloides*)
paper birch	(*Betula papyrifera*)

Shrubs: a very well-developed, tall, vigourous layer.

red-osier dogwood	(*Cornus sericea*)	-dominant shrub, red branches prominent in winter
thimbleberry	(*Rubus parviflorus*)	-usually dominant
highbush-cranberry	(*Viburnum edule*)	
wild roses	(*Rosa acicularis*, *R. nutkana*)	
black twinberry	(*Lonicera involucrata*)	
falsebox	(*Paxistima myrsinites*)	
Saskatoon	(*Amelanchier alnifolia*)	
common-snowberry	(*Symphoricarpos albus*)	
Scouler's willow	(*Salix scouleriana*)	

Herbs: a very well-developed, vigorous layer; diverse species composition.

false sarsaparilla	(*Aralia nudicaulis*)
purple peavine	(*Lathyrus nevadensis*)
false Solomon's-seal	(*Smilacina racemosa*)
queen's cup	(*Clintonia uniflora*)
pink wintergreen	(*Pyrola asarifolia*)
bunchberry	(*Cornus canadensis*)
[sweet-scented bedstraw	(*Galium triflorum*)]
[mountain sweet-cicely	(*Osmorhiza chilensis*)]
[trailing raspberry	(*Rubus pubescens*)]
[star-flowered false Solomon's-seal	(*Smilacina stellata*)]

Moss layer: very poorly developed, frequently absent except on tree bases and decaying wood.

Remarks: This seral ecosystem association is well-established at low elevations in the ICHg3 and includes productive stands with a heavy or totally deciduous cover. Lodgepole pine and western redcedar are scattered in some stands. Coniferous regeneration is sparse and suppressed by the heavy undergrowth of shrubs and herbs. Succession to a conifer-dominated climax is therefore a very slow process.

Note the absence of *Vaccinium* spp. in the shrub layer and the lack of a moss carpet. Heavy deciduous litterfall and shading by more aggressive seral species prevent establishment of these typical climax plants.

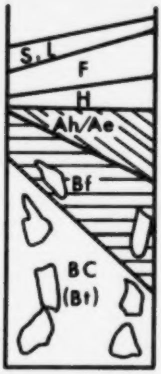
ICHg3/10 ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION

SOILS: Soil profiles have developed primarily on morainal blankets that have undergone some fluvial modification since glaciation. Sandy to loamy B horizons generally have yellowish red (Bf) to yellowish brown colours. These horizons are overlain by a very dark brown to black horizon (Ah) and/or a leached, acidic pale brown surface horizon (Ae). Subsurface mineral horizons are of two forms: olive brown, loamy sands that are well-drained and formed primarily through fluvial processes; or grayish brown horizons containing more clay (Bt), and only moderately well-drained. In the finer soils, the volume of coarse fragments (variable) may improve subsurface drainage considerably.

Soil Classification: Orthic Humo-Ferric Podzols; Orthic Eutric Brunisols; Podzolic Gray Luvisols.

Humus Form Classification: Orthimormoders.

Schematic Profile:



Orthic Humo-Ferric Podzol
(Podzolic Gray Luvisol)

Horizon	Description
F	- moderately decomposed; moist; dark brown organic; loose structure; abundant fine, medium roots; common fungal mycelia and/or zoogenous droppings; basic pH.
Ah/Ae	- pale brown (leached) and/or very dark brown (high organic matter %); plentiful to abundant fine, medium roots; variable thickness.
Bf	- yellowish brown to yellowish red; sandy to loamy; few to plentiful roots.
BC (Bt)	- yellowish brown to grayish brown; sandy to clayey; structureless to angular blocky.

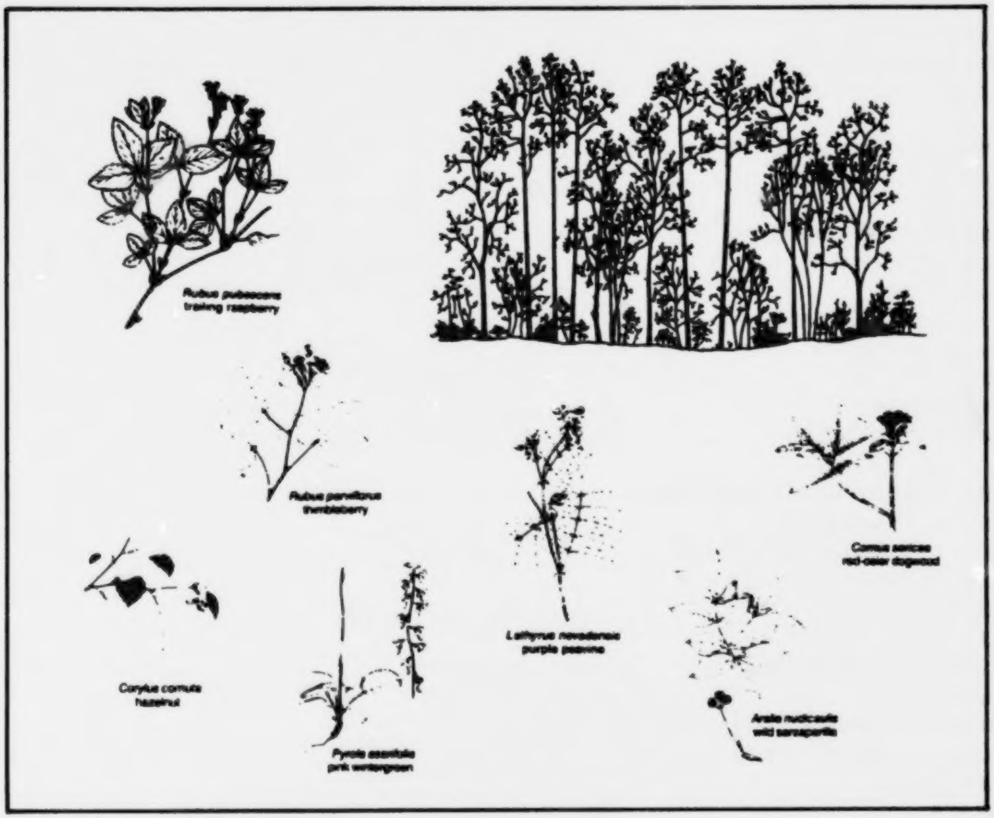
Average pH: mineral horizons - 5.3
organic horizons - 5.5

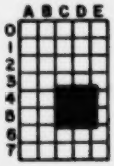
Key Characteristics:

- relatively nutrient-rich surface organic layers, ranging from 5 to 10 cm in total thickness.
- relatively rich surface mineral horizons, well-drained to at least 40 cm.
- effective rooting variable, ranging from 30 to 70 cm in depth.
- subsurface mineral horizons vary from coarse, well-drained to more compacted, clayey till.

ICHg3: HAZELTON VARIANT

/10(a) ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION: HAZELNUT FLUVIAL PHASE (236)


Rubus pubescens
trailing raspberry
Rubus parviflorus
thimbleberry
Lathyrus nevadensis
purple peavine
Cornus sericea
red-osier dogwood
Corylus cornuta
hazelnut
Pyrola asarifolia
pink wintergreen
Aralia nudicaulis
wild sarsaparilla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ECOLOGICAL MOISTURE REGIME:
mesic - subhygric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic

DISTRIBUTION: very common at low elevations in the central part of the ICHg3; characteristic of the Kitwanga - Hazelton - Kispiox area.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floors and river terraces; upper to lower slopes in rolling terrain.

Slope range: level to moderately sloping (0 - 35%).

Surface shape: flat to straight; occasionally slightly concave or convex.

Landforms: primarily fluvial and glaciofluvial; river terraces and sloping fluvial deposits; rarely on coarse textured, washed morainal deposits.

ICHg3/10(a) ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION: HAZELNUT FLUVIAL PHASE

VEGETATION:

Trees: dominantly or totally deciduous cover.

trembling aspen	(*Populus tremuloides*)
paper birch	(*Betula papyrifera*)
[hybrid spruce	(*Picea glauca* x *sitchensis* ? x *engelmannii*)]
[black cottonwood	(*Populus balsamifera* ssp. *trichocarpa*)]

Shrubs: a very well-developed, vigorous, tall layer.

hazelnut	(*Corylus cornuta*)	-characteristic dominant shrub
red-osier dogwood	(*Cornus sericea*)	
thimbleberry	(*Rubus parviflorus*)	-usually dominant
wild roses	(*Rosa acicularis*, *R. nutkana*)	
highbush-cranberry	(*Viburnum edule*)	
black twinberry	(*Lonicera involucrata*)	
[Scouler's willow	(*Salix scouleriana*)]	
[Douglas maple	(*Acer glabrum*)]	
[common-snowberry	(*Symphoricarpos albus*)]	

Herbs: a very well-developed, vigorous layer; diverse species composition.

purple peavine	(*Lathyrus nevadensis*)
wild sarsaparilla	(*Aralia nudicaulis*)
star-flowered false Solomon's-seal	(*Smilacina stellata*)
pink wintergreen	(*Pyrola asarifolia*)
trailing raspberry	(*Rubus pubescens*)
bedstraws	(*Galium triflorum*, *G. boreale*)
mountain sweet-cicely	(*Osmorhiza chilensis*)
false Solomon's-seal	(*Smilacina racemosa*)
bunchberry	(*Cornus canadensis*)
asters	(*Aster ciliolatus*, *A. conspicuus*, *A. subspicatus*)
[black snake-root	(*Sanicula marilandica*)]
[blue wildrye	(*Elymus glaucus*)]

Moss layer: poorly developed, frequently absent; mosses mainly restricted to decaying wood and tree bases.

Remarks: Aspen - birch seral stands with an understory of hazelnut are highly characteristic of the central ICHg3 and occur infrequently elsewhere. The Hazelnut fluvial phase is a very productive ecosystem unit for aspen and birch. Spruce also grows very well on these sites, but it is rarely a major component of the stand. The heavy deciduous litterfall and competition from aggressive shrub and herb species prevents most coniferous regeneration (especially hemlock) from becoming established.

This phase is somewhat more productive than the typical Aspen - birch red-osier dogwood seral ecosystem association (ICHg3/10), but aside from the dominant cover of hazelnut, the understory species composition is very similar.

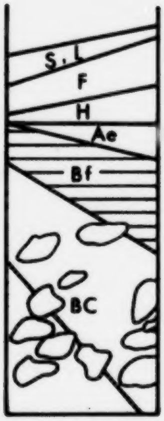
ICHg3/10(a) ASPEN - BIRCH - RED-OSIER DOGWOOD SERAL ECOSYSTEM ASSOCIATION: HAZELNUT FLUVIAL PHASE

SOILS: Soil profiles of this phase have formed on inactive fluvial and glaciofluvial landforms that are well-drained with a high gravel content, particularly in subsurface mineral horizons. Strong brown (Bf) to dark yellowish brown (Bm) horizons dominate the upper 30 cm of the profile. However, there are a few soils showing little or no profile development (structureless sands, gray colours) in more recent fluvial deposits. A leached, light brownish gray mineral horizon (Ae) may have formed above Bf and Bm horizons in the older, better developed profiles. Fairly rich organic layers have formed primarily through zoogenous decomposition of leaf litter.

Soil Classification: Orthic Humo-Ferric Podzols; Orthic and Eluviated Dystric Brunisols: minor Orthic Regosols.

Humus Form Classification: Orthimormoders; Orthileptomoders.

Schematic Profile:



Horizon	Description
S/L	- loose, undecomposed leaves and/or needles plus moss layer.
F	- loose; partially decomposed; dark brown; dominantly zoogenous decomposition; plentiful fine roots.
H	- massive to blocky; well-decomposed; dark brown; plentiful medium and coarse roots.
Bf	- strong brown to reddish brown; loamy sand to sand; structureless; plentiful to abundant medium, coarse roots.
BC	- yellowish-brown to light olive brown; sandy; single grain; few fine roots; signficant coarse fragment content (greater than 40%).

Orthic Humo-Ferric Podzol

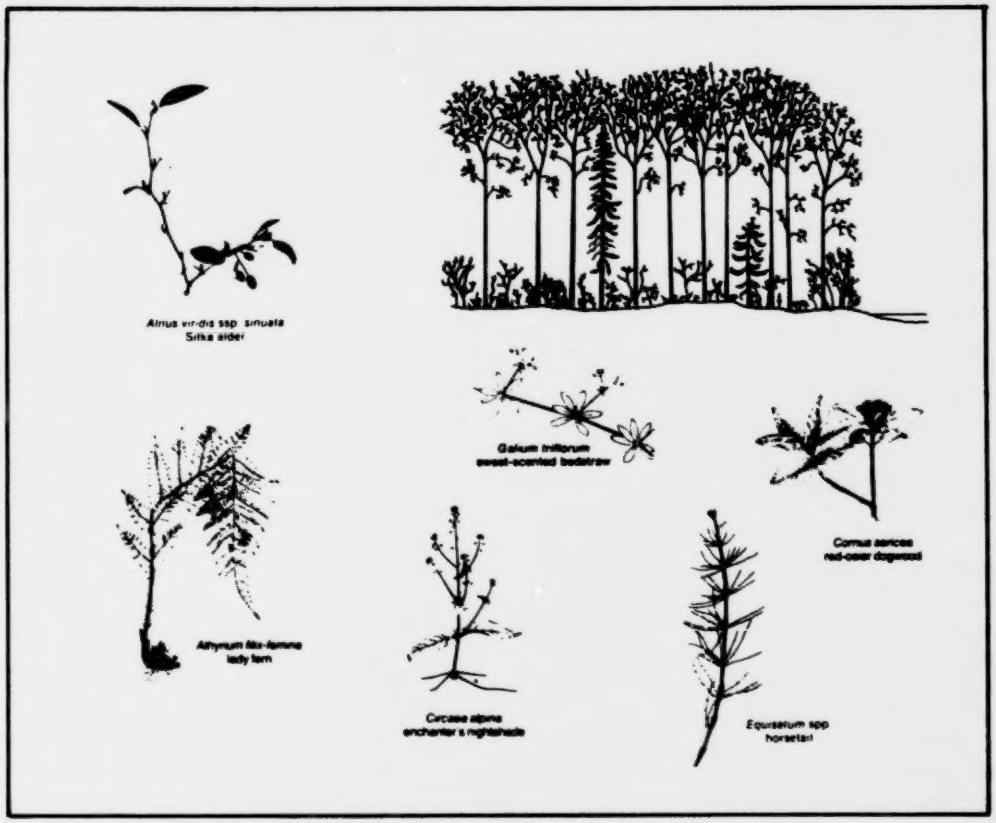
Average pH: mineral horizons - 5.1
organic horizons - 5.4

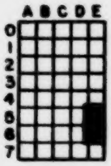
Key Characteristics:

- relatively coarse textured, freely drained soils developed from fluvial and glaciofluvial parent materials.
- organic horizons are relatively nutrient-rich (higher pH), rapidly decomposed, and range between 4 and 10 cm in depth.
- younger fluvial deposits may show limited soil development.
- effective rooting relatively deep (often greater than 50 cm).
- high % of rounded coarse fragments below 50 cm depth.

ICHg3: HAZELTON VARIANT

/11 FLOODPLAIN COTTONWOOD SERAL ECOSYSTEM ASSOCIATION (237)


Alnus viridis ssp. sinuata
Sitka alder
Galium triflorum
sweet-scented bedstraw
Cornus sericea
red-osier dogwood
Athyrium filix-femina
lady fern
Circaea alpina
enchanter's nightshade
Equisetum spp
horsetail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ECOLOGICAL MOISTURE REGIME:
(mesic+) - subhygric - hygric

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - eutrophic

DISTRIBUTION: common on floodplain islands and river bottomlands along the Skeena and Bulkley rivers and their major tributaries.

PHYSIOGRAPHIC FEATURES:
Slope position: valley floor.
Slope range: level (0 - 2%).
Surface shape: flat, often cut by floodwater channels.
Landforms: active fluvial (alluvial) sediments; subject to flooding.

ICHg3/11 FLOODPLAIN COTTONWOOD SERAL ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: very large, open grown, excellent vigour.

black cottonwood	(Populus balsamifera ssp. trichocarpa)	
[hybrid spruce	(Picea glauca x sitchensis ? x engelmannii)]	)-primarily sub-
[western redcedar	(Thuja plicata)]	) canopy trees

Shrubs: a well-developed, very tall layer.

red-osier dogwood	(Cornus sericea)	-characteristic dominant
mountain alders	(Alnus viridis ssp. sinuata, A. incana ssp. tenuifolia)	
willows	(Salix spp.)	
highbush-cranberry	(Viburnum edule)	
black twinberry	(Lonicera involucrata)	
wild roses	(Rosa acicularis, R. nutkana)	
[red raspberry	(Rubus idaeus)]	
[currants and gooseberries	(Ribes spp.)]	

Herbs: a well-developed, vigorous layer.

horsetails	(Equisetum arvense, E. pratense, E. hyemale)
sweet-scented bedstraw	(Galium triflorum)
pink wintergreen	(Pyrola asarifolia)
enchanter's nightshade	(Circaea alpina)
lady fern	(Athyrium filix-femina)
false Solomon's-seal	(Smilacina racemosa)
star-flowered false Solomon's-seal	(Smilacina stellata)
mountain sweet-cicely	(Osmorhiza chilensis)
grasses	(Elymus glaucus, Calamagrostis canadensis, and others)
trailing raspberry	(Rubus pubescens)
[goatsbeard	(Aruncus dioicus)]
[cow-parsnip	(Heracleum sphondylium)]
[palmate colt's-foot	(Petasites palmatus)]

Moss layer: very poorly developed, generally absent except on decaying wood and tree bases.

Remarks: This seral ecosystem unit is the most productive growing site in the ICHg because of its abundant moisture and the continuous influx of nutrients through flooding. Cottonwood is the fastest growing tree but spruce and cedar also grow extremely well. Coniferous species are slow to establish themselves beneath the canopy of cottonwood because of intense competition from shrubs and herbs. Flooding and erosion generally prevent the site from stabilizing long enough for a Spruce - cedar - horsetail climax community to develop.

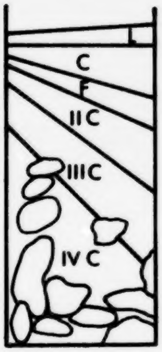
ICHg3/11 FLOODPLAIN COTTONWOOD SERAL ECOSYSTEM ASSOCIATION

SOILS: Soil profiles are poorly developed (little coloration or structure) as a result of regular flooding by rivers and streams. Surface organic materials are often less than 2 cm thick in these active fluvial areas. Sequences of buried organic layers are also characteristic of floodplain soils. Surface horizons may contain a thin, weakly developed brown layer (Bm), although gray, sandy horizons usually dominate the entire profile.

*Soil Classification: Cumulic and Orthic Regosols.

Humus Form Classification: absent or thin Orthivelomoders.

Schematic Profile:



Horizon	Description
L	- loose, undecomposed leafy litter.
C	- dark grayish-brown; very fine sand to silt; single grain; abundant fine, medium coarse roots.
F	- slightly decomposed; brown organic horizon; compact matted; plentiful medium roots.
IIC	- dark gray; fine sandy; few to plentiful, fine and medium roots.
IIIC	- dark gray; coarse sandy; few fine roots.
IVC	- dark olive gray; coarse sandy; mottling may be present; may be stoney.

Cumulic Regosol

*Average pH: mineral horizons - 6.5
organic horizons - 6.1

Key Characteristics:

- rich, recent floodplain deposits (higher, basic pH).
- very thin accumulation of surface organic materials (less than 5 cm).
- fluvial deposits have variable textures from very fine sands and silts (well-drained) to coarse sandy gravels (rapidly drained).
- common occurrence of buried organic and mineral horizons, and mineral intermixing in organic layers.
- frost heaving problems in silt textured soils.

*NOTE: limited sampling of this ecosystem association.

8 SILVICULTURAL MANAGEMENT INTERPRETATIONS

8.1 Introduction

Ecological classification provides an excellent basis for developing management prescriptions. The use of this classification, for example in the implementation of silvicultural prescriptions, will improve forest management. Figure 15 shows the relationship between the processes of classification, interpretation, and stand management and their respective products: ecosystem units, silvicultural prescriptions, and "productive" forests. Stand management proceeds with the implementation of the silvicultural prescriptions or, if required, with the modification of them to accommodate other management concerns such as protection or logging constraints. These other concerns alone must not determine actual stand and forest management. The silvicultural prescription should provide the direction and the guidance to satisfy all concerns without compromising good forest management.

The prescriptions of this guide were developed by:

i) compiling local experience (A. Kokoshke, D. Annas, J. Standish, A. Waters, and Forest Service staff of Terrace and Hazelton Districts). Individuals who had made their own interpretations were interviewed and had their work reviewed. Their conclusions and recommendations were then edited and incorporated into this guide.

ii) examining past practices. Over 50 individual ecosystem units were examined in the fall of 1980 to assess the effects of present logging methods, site preparation techniques, and reforestation practices. Subsequent field checks were made in 1981, 1982, and 1983, especially in the lesser known portions of the subzone.

iii) reviewing the literature. Much of the relevant literature was reviewed to substantiate the prescriptions. We used only those articles we thought were pertinent to this subzone.

iv) considering the management objectives of the Prince Rupert Forest Region. These objectives include:

- to maintain or improve site
- to produce sawlogs

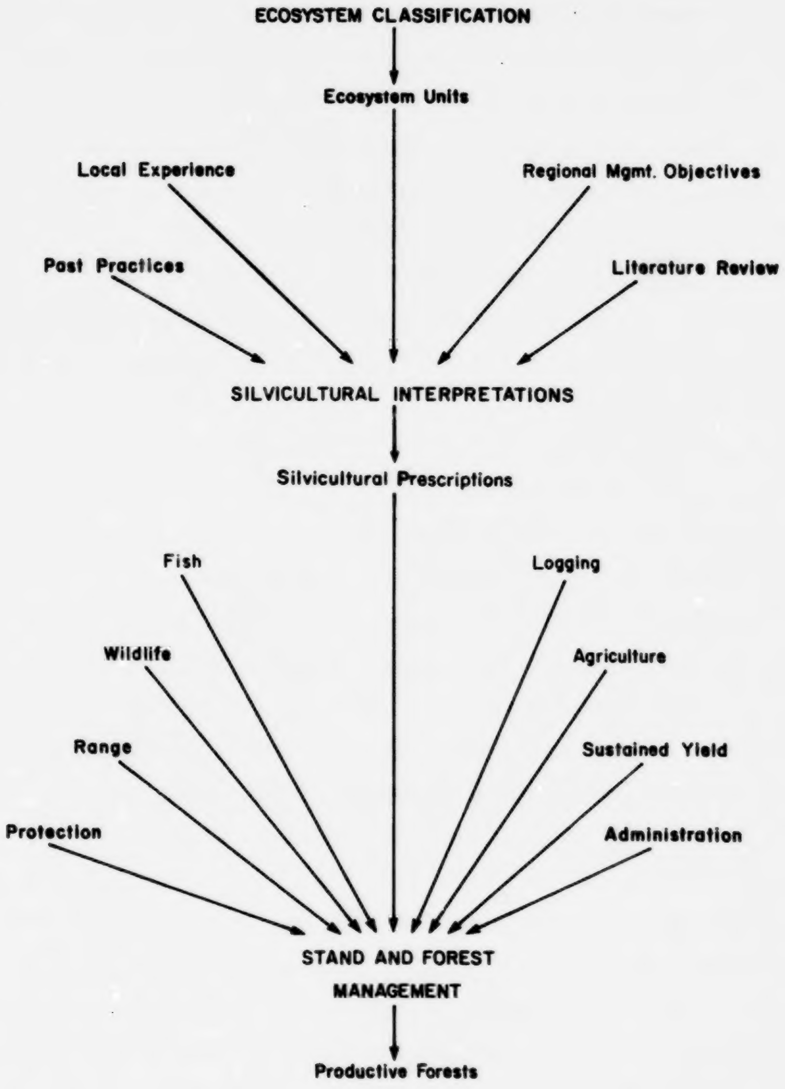

ECOSYSTEM CLASSIFICATION
Ecosystem Units
Local Experience
Regional Mgmt. Objectives
Past Practices
Literature Review
SILVICULTURAL INTERPRETATIONS
Silvicultural Prescriptions
Fish
Logging
Wildlife
Agriculture
Range
Sustained Yield
Protection
Administration
STAND AND FOREST MANAGEMENT
Productive Forests

FIGURE 15. The relationship between classification, prescription, and management.

- to ensure "free growing" stands with suitable species and acceptable stocking
- to achieve an average rotation age of 80 years
- to space all suitable stands

This interpretive part of the guide is an attempt to summarize past silvicultural practices and standardize future establishment efforts in the ICHg. As we learn more, it is anticipated that not only will silvicultural prescriptions improve and broaden, but also more kinds of prescriptions will be added, such as those that involve forest protection, range, recreation, fish, and wildlife considerations. Those who apply the following information should pass on their experiences -- constructive criticism, new information, and suggestions -- so that future revisions and additions will reflect their findings.

Section 8.2 of this interpretive material discusses management activities that occur in the ICHg, while Section 8.3 presents specific prescriptions for each ecosystem unit. Both sections are initially required to give users a full appreciation of the prescriptions and their usefulness. We refer the reader to the literature cited for additional clarification. However, for quick reference and field guidance, Section 8.3 will provide sufficient information for dealing with individual cut blocks.

8.2 MANAGEMENT CONSIDERATIONS FOR THE ICHg

This section discusses early stand management activities with limited reference to specific ecosystem units. These activities will be dealt with in the "normal" chronological order of logging, site preparation, reforestation, and control of insects and disease, although in practice two or three activities often occur simultaneously.

8.2.1 Logging

Logging activities, (falling, yarding, and hauling) along with the prerequisite layout and scheduling, rarely are seriously viewed in this Forest Region as methods of site preparation and reforestation. There are, however, many times when harvesting could be modified for just those purposes. In so doing, logging could benefit total stand management without incurring significant additional costs. Consider the following:

i) Regeneration systems

The dominant logging method in the ICHg is clearcutting with either high-lead or ground-lead yarding systems. However, other logging methods may be preferable on some sites. For example, on ecosystems that are very difficult to regenerate without causing site degradation or creating microclimatic extremes (e.g., Dry Hemlock - moss: ICHgl/03 or Horsetail: ICHgl/06), a diameter-cut or selective system with skidder yarding may be the preferred alternative (Jerry Franklin, personal communication, 1981). This, of course, assumes a suitable logging chance as well as an acceptable residual stand (in terms of species, age, logging damage, etc.).

ii) Layout and scheduling

Logging can often make subsequent management activities much easier and more successful. For example, instead of including ecosystems that range from very dry to very brushy in one opening, two openings could be made (or one opening split by a year of logging). The brushy areas could be logged, burned, and planted before treating the other, drier areas, which should not be burned. Ideally openings that have extreme brush potential should be scheduled so that falling, yarding, hauling, salvage, site preparation, and planting all occur in one year. With current manpower and man-day allocations this is very difficult. The only acceptable alternative is to immediately provide compensating activities, in particular brushing and weeding and/or cleaning and/or fill-planting of failed plantations, and/or release as well as repeat treatments.

iii) Advanced regeneration

Protecting acceptable advanced regeneration at the harvesting stage can save significant time, effort, and money in establishing the next crop. For a more detailed discussion see Section 8.2.2.1.

iv) Slash

Forest managers can reduce slash problems (breakage, fire hazard, poor planter access, poor distribution of seedlings) by modifying the logging of an opening (Ruth and Harris 1975). Several methods are available:

- improved utilization: smaller top diameters, lower stumps, using shorter and more defective chunks, careful felling and bucking, extracting all species;
- improved planning: better deflection, uphill over downhill yarding;
- prelogging: improved salvage operations, specialty products (shakes, posts);
- Y.U.M.: Yarding Unutilized Material.

Economic conditions in the past have often resulted in relaxation of standards so that slash was dramatically increased. Managers must then be prepared to increase post logging management efforts at a later date.

v) Productive area (Schwab 1978[12]; Schwab and Watt 1981; Smith and Wass 1979, 1980)

The running surface of landings and major skid trails often does not regenerate satisfactorily. Even though they may appear acceptably stocked through planting or natural seeding, the resulting trees are generally of much poorer quality (height and colour) than those of the opening. Landings and roads, particularly skidder "shows", have removed a significant amount (up to 50% [H.I. Hammond, personal communication, 1981]) of some openings from production by removing and/or compacting soil horizons. To reduce this problem, design and schedule openings to reduce the number and size of landings and major haul roads (Hammond 1982).

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[12] Schwab, J.W. 1978. Soil disturbance associated with tractor skidding, access logging, and high yield yarding in the Prince Rupert Forest District. Unpublished report. B.C. Min. For., Smithers, B.C.

Road building and logging increase the risk of erosion. Those erosion features that may result in the loss of an area for at least the next rotation include debris slides, debris avalanches and flows, slump earthflows, gullying, and debris torrents. Addressing these potential problems at the planning and layout stages often reduces the risk of severe erosion.

8.2.2 Site preparation

Site preparation traditionally is the first management activity that focuses on silviculture: the control of the establishment, growth, and composition of the future stand. Methods of site preparation have often doubled as methods of protection (fire hazard abatement and pathological control), with the two types of treatment differing only in their objectives. This discussion will not consider methods as such, but instead will examine issues that need to be addressed before a site preparation plan is formulated. These issues involve advanced regeneration, prescribed fire, and brush potential.

8.2.2.1 Advanced regeneration

The utilization of acceptable advanced regeneration can reduce the logging rotation up to 10 years (normally 2 or 3 years). The acceptability of advanced regeneration depends on a species' suitability for the site and on its density, distribution, and quality. Unfortunately, acceptable advanced regeneration is uncommon in the ICHg compared to the CWHf.

The majority of literature on the management of advanced regeneration in British Columbia and elsewhere has dealt with the true fir species (see Smith and Craig 1970; Alexander 1974; Crossley 1976; Herring and Etheridge 1976; Gravelle 1977; Herring 1977, 1979; Johnstone 1978). In general, the information provided on the true firs can also be applied to spruce, hemlock, and cedar. The major points of the above papers are:

i) Any form of logging is likely to destroy a substantial proportion of the advanced regeneration on a site, although total destruction is probably rare. Expect between one-half and two-thirds of the advanced regeneration existing in a stand to be destroyed during the logging operation.

ii) Age and size of advanced regeneration are not directly related, making an accurate age prediction based on relative size unreliable. Age alone can not be used as a predictor of growth performance or merchantable value.

iii) The quality of advanced regeneration in relation to its potential for forming a second rotation crop is best described in terms of its vigour, susceptability to decay, and the growth form of its stem and crown. For a useful guide as to what is acceptable quality refer to: Regeneration Survey Standards for Advanced Amabilis Fir in the Vancouver Forest District. District Reforestation Staff. Vancouver. (1977?).

8.2.2.2 Prescribed burning

Fire is prescribed in expectation of many kinds of benefits. In the ICHg these include:

i) site preparation - brush retardation, species conversion, stocking control, planting ease;

ii) protection - hazard abatement, pathological control.

These benefits are well known because they are immediately and obviously available. They weigh heavily in decision-making processes that include fire as an alternative. Drawbacks, excluding escaped burns and some disease and insect problems, likely manifest themselves much later, are not as well known or substantiated, and therefore weigh relatively little in those decisions. These drawbacks mainly concern losses in future productivity and include chemical, physical, and biological changes in the soil. For a complete discussion based on an extensive literature review see Macadam (1981)[13] and Feller (1982).

Early indications of the long-term effects of fire (Czapowskyj _et al_. 1977; Kraemer and Herman 1979; McMinn 1979) suggest that it is often possible to burn without causing significant site degradation. However the burn must be intelligently prescribed and properly implemented (e.g. Chrosciewicz 1967, 1978_a_ and _b_; Martin 1976). Burning on "riskier" sites (drier, southern aspects, heavier slash, higher coarse fragment content, higher brush potential) requires an appropriate change in emphasis (for compensating activities, see Section 8.2.1, i and ii) to avoid plantation failures. In particular, it requires more precise and detailed planning, closer supervision, and less tolerance of flexibility in implementation (quality of stock, stock handling, planting quality, and scheduling). If that change in emphasis cannot be guaranteed, then burning should not proceed. Some sites, however, should _not_ be burned under any circumstances: dry (submesic and drier) sites with thin (less than 5 cm), organic horizons, steep slopes subject to erosion, and areas unplantable due to soil conditions (such as large amounts of coarse fragments).

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[13] Macadam, A. 1981. Effects of prescribed fire on forest soils in the Prince Rupert Forest Region. An interim report. Unpublished manuscript. B.C. Min. For., Smithers, B.C.

8.2.2.3 Brush[14]

Brush potential is a function of the ecosystem, the abundance (and sometimes vigour) of brush species (see Table 5) before harvesting, and the amount of logging disturbance. The prescriptions that follow (Section 8.3) designate the brush potential of each ecosystem unit as either low, medium, or high. These ratings can also be determined by considering the criteria listed in Table 6. High brush potential areas are not difficult to identify before they become a problem and must be scheduled, in advance of logging, for prompt reforestation (AS PRIORITY) with appropriate contingency plans and frequent follow-up. Typically, the most productive ecosystems also have the highest brush potential. Once brush has taken control, reclamation is neither easy nor inexpensive. Managers must be prepared to accept the responsibility and the cost should reclamation be required (i.e., compensating activities). Otherwise, cut-over land with severe brush problems should be removed from the annual allowable cut (= timber mining).

8.2.2.4 Aspect

In mountainous terrain of the ICHg, aspect can significantly affect the local climate. On south-facing slopes (in comparison to an equal ecosystem unit on a north slope) one finds:

higher insolation - higher fire hazard and risk
- lower survival due to greater moisture stress (particularly in drier ecosystems);
valley updrafts - seed blown uphill.

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[14] Deciduous trees, shrubs, and herbs that inhibit the successful establishment and growth of selected coniferous tree species.

TABLE 5. Major brush species of the ICHg

Trees:	cottonwood	*Populus balsamifera* ssp. *trichocarpa*
	willows	*Salix* spp.
	paper birch	*Betula papyrifera*
	trembling aspen	*Populus tremuloides*
	[Sitka alder	*Alnus viridis* ssp. *sinuata*]
Shrubs:	red-osier dogwood	*Cornus sericea*
	highbush-cranberry	*Viburnum edule*
	thimbleberry	*Rubus parviflorus*
	black gooseberry	*Ribes lacustre*
	[huckleberries and blueberries	*Vaccinium* spp.]
	[devil's club	*Oplopanax horridus*]
	[hazelnut	*Corylus cornuta*]
	[raspberry	*Rubus idaeus*]
	[willows	*Salix* spp.]
Herbs:	spiny wood fern	*Dryopteris assimilis*
	lady fern	*Athyrium filix-femina*
	cow-parsnip	*Heracleum sphondylium*
	[grasses]	
	[fireweed	*Epilobium angustifolium*]

TABLE 6. Criteria for determining brush potential

Criterion	Brush Potential		
	Low	Moderate	High
Moisture regime	xeric - mesic	mesic - subhygric	subhygric - hygric
Nutrient regime	low - medium	medium - rich	rich - very rich
Dominant understory* in forested ecosystem	moss and herbs; few shrubs	mostly herbs; moderate number of shrubs	abundant competitive shrubs and deciduous trees
Logging disturbance	low	medium	high
Relative rate and dominant mode of decomposition	slow/fungal	moderate/fungal-zoogenous	moderate to fast/ zoogenous (fungal)
Drainage class	(moderately well) to well	well to imperfectly	(moderately well) to poorly
Seepage	rarely present	may be periodically present	periodically to permanently present
Water table	not present within 100 cm of ground surface	rarely present within 100 cm of ground surface	frequently present within 50 cm of ground surface
Mottling or gleying in upper 50 cm	not present	may be present	frequently present
Meso slope position	variable slope positions	- middle - lower - toe - (level)	- lower - toe - level - depressional

*Quantity and vigour of these species is directly related to crown closure as well as moisture and nutrient regime.

8.2.3 Planting: species/stock type selection

In this guide, a preferred species is a currently commercial species that we predict will produce the greatest maximum mean annual increment per tree. An acceptable species will reach merchantable size in a reasonable period of time, but at a slower rate than the preferred species. An unacceptable species will not reach merchantable size, in a reasonable period of time, when compared to its associates.

The selection of species and stock type is influenced by many kinds of variables including silvics, ecology, transportation, nursery budgets, accessibility, site conditions, experience of planters, and timing of planting. Given the ideal combination of these variables, the "best" stock generally is the biggest and most balanced (see Table 7). However, the best stock is usually very limited in supply. Until this situation improves the optimum approach seems to be: "order (sowing request) what is best for the site but plant (stock allocation) what you can get away witn" (G. Grunerud, personal communication, 1981). This approach fulfills two important objectives: 1) the nurseries will be aware of field needs; and 2) the riskiest sites (with respect to plantation failure) will receive the best available stock. Accordingly, Table 8 lists the major ecological factors to be considered and suggests appropriate stock types to match. For a general reference see Sections 4 and 6, Silviculture Manual, British Columbia Ministry of Forests.

8.2.4 Insects and disease

Insect and disease problems occur in all types of ecosystems of the ICHg. Potential problems must be recognized or anticipated and taken into account in all silvicultural prescriptions. The identification and treatment of the various forest insects and diseases are adequately covered in the literature (e.g., Baranyay and Smith 1972; Laurent 1974; Thomas et al. 1975; McMullen 1976; Wallis 1976; Scharpf and Parmeter (editors) 1978; Rudinsky 1979; Cole and

TABLE 7. Relative quality of some commonly planted stock (position within column is more reliable than among columns)

Quality	Available now				Available in near future			
	Sx[*],[**]		Pl		Hw	Hm	Cw	
	Cont.[***]	BR[//]	Cont.	BR	Cont.	Cont.	Cont.	BR.
Best	415[#]							
		Plug+1						
	313		211	1.5				
				+.5				
		2.5+2						Plug+1
				2+1				
	211						S.L.[●]	
		2+0		2+0	211	211		
		1.5+1						
Least Best								

[*] Tree species symbols as in Appendix 2.

[**] Be very careful to use local provenances.

[***] Container (no planting check).

[//] Bare root (possible planting check).

[#] Special circumstances only.

[●] Spencer-Lemaire.

TABLE 8. Guidelines for stock type selection in the ICHg

Site Condition	Site Problem	Species/Stock Type
Micro-climatic extremes	large temperature or moisture extremes	-Pl 1 1/2 + 1/2 - small, well balanced
Fine textured soils (silts)	frost heaving	-high root/shoot mass ratio -Pl 1 1/2 + 1/2 BR -Sx BR with long roots -Plugs - only in spring when frost danger is over
Brush	shading - light - temperature mechanical damage - whipping	-tall, sturdy transplant stock that releases quickly; Sx - Plug + 1
Dry sites - coarse textures - skeletal soils	drought - moisture stress (high evap., low soil water retention)	-high root/shoot mass ratio and small tops -Pl 1 1/2 + 1/2 BR -Plug 211
Severe disturbance - fire, MSP, erosion, logging	site pushed back to earlier seral stage	-choose earlier seral species if required; i.e., Pl over Sx unless brush will be a problem
Otherwise	no problems	flexible; e.g. 2 + 0 BR, Plug 211

Amman 1980; Stock 1981[15]; Canadian Forestry Service, Forest Pest Leaflets) and will not be dealt with in detail here. Table 9 presents a summary of the major insects and diseases of commercial tree species in the ICHg.

8.3 Silvicultural Prescriptions

In the preceding sections we have discussed the major silvicultural topics that must be considered in the formulation of a silvicultural prescription for an ecosystem association. In Sections 8.3.1 to 8.3.5, respectively, we present silvicultural prescriptions for each forested ecosystem association of the Interior Cedar - Hemlock "g" subzone (except for the ICHg5). These prescriptions should serve as guides in the selection of appropriate silvicultural treatments on an ecosystem basis. The ability to identify the ecosystem associations is a prerequisite for use of the prescriptions. The silvicultural prescriptions are summarized in Tables 10-13. Ecosystems that are essentially similar with respect to silvicultural treatments have been combined. The prescriptions have been laid out in a manner that provides the user with an increasing level of detail as follows:

i) PRESCRIPTION - succinctly outlines the recommended options.
ii) CAUTIONS - provides additional information and qualifications on the PRESCRIPTION.
iii) COMMENTS - elaborates on and broadens the PRESCRIPTIONS and CAUTIONS.
iv) At this point, if users desire more guidance they can return to the introductory Section 8.1 for clarification and literature references.

The terms used under ACTIVITY in the silvicultural prescriptions are all self-explanatory except possibly MSP, which is an abbreviation for mechanical site preparation.

The COMMENTS are also self-explanatory except the parentheses around some species abbreviations under SPECIES SELECTION. Parentheses should be translated to read "in some situations".

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[15] Stock, A.J. 1981. Guidelines for control of dwarf mistletoe in the Prince Rupert Forest Region. Unpublished manuscript. B.C. Min. For., Smithers, B.C.

TABLE 9. Major insects and diseases of the ICHg*

Insects	Target species**	Severity in subzone	Comments
Mature trees			
mountain pine beetle (*Dendroctonus ponderosae*)	Pl	Severe	Epidemic since 1969. Most northerly occurrence (1981) at Vandyke Island (Nass River).
spruce beetle (*Dendroctonus rufipennis*)	S	Light - Moderate	Previous losses from Cedarvale to Kitwanga Lake. Infestations in upper Nass Valley - 1945-49. Presently (1981) scattered small groups along Cranberry and Nass rivers. Has potential to be a severe problem in the upper Kispiox Valley.
spruce budworm (2 - year cycle) (*Choristoneura biennis*)	Sw, Bl	Light - Moderate	Light defoliation from 2nd crossing Bell-Irving River south to Meziadan Lake (1980). Lighter defoliation in 1981; has potential of spreading throughout Kispiox Valley.
hemlock sawfly (*Neodiprion tsugae*)	Hw	Light	Two patches of moderate-severe defoliation around Kispiox Valley (1978). No defoliation in 1980.
forest tent caterpillar (*Malacosoma disstria*)	At, Ep, D; Willow	Light	Infestations appear every 5-7 years. Up to 100% defoliation; previously along Skeena, Kitwanga and lower Nass rivers. No recent damage.

TABLE 9. (cont'd)

Insects	Target species**	Severity in subzone	Comments
Mature trees			
western balsam bark beetle (*Dryocoetes confusus*)	Bl	Severe	Epidemic in the 1940's especially around Jigsaw Lake (Oliphant Lake). Severe recurrence in 1965 south of the Kwinageese River. The *Dryocoetes* - *Ceratocystis dryocoetidis* insect/fungus complex wiped out thousands of hectares of Bl stands in the ICHg1 in the 1940's and middle 1960's. It persists today mostly at endemic levels.
Seedlings			
aphids (*Pineus* sp.)	Sw	Light	Almost all the spruce plantations are infested to some extent by this aphid; however, most trees seem to grow through the severe infestation stage. Some spruce trees seem to be extremely susceptible to this insect and are severely infested year after year - never growing - becoming totally deformed as well as supplying a steady population of aphids to infest the other trees; common in the Kispiox Valley, Date Creek, Sweetin River - particularly in dry ecosystems.

TABLE 9. (cont'd)

Insects/Diseases	Target species**	Severity in subzone	Comments
Seedlings			
blackarmy cutworm (*Actebia fennica*)	Sw, Pl	Light	Special circumstances (fall burn - spring plant) could result in this insect causing severe damage to new plantations.
spruce weevil (*Pissodes strobi*)	Sw	Light	Common on roadside regeneration, but as yet no problem in plantations in subzone.
dwarf mistletoe (*Arceuthobium tsugense*) (*A. americanum*)	Hw Pl	Light - Moderate Light	Severe infections in mature hemlock in Hoodoo Lake area and along Kinskuch and Nass rivers. Northerly limit appears to be just north of Meziadin Lake. A few scattered infections along Skeena and Kispiox rivers.
leaf and twig blight of poplars (e.g., *Melampsora* spp., *Venturia* spp.)	At, Act	Light - Moderate	Has caused up to 100% foliage burning within the range of At and Act in the subzone. No tree mortality recorded.
western gall rust, (*Endocronartium harknessii*), stalactiform rust, (*Cronartium coleosporioides*) lodgepole pine canker (*Atropellis* sp.)	Pl	Light	Common, producing branch and stem galls throughout subzone. These diseases are a potential problem in pine plantations
root rots (e.g., *Armillaria*, *Phellinus*, *Fomes*)	Hw, Bl, Sw	Light?	No surveys have been conducted to quantify what the losses are in the Northern forests - but these root rots are present in all the mature forest types.

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*Peter Koot, Don Doidge, Kevin Widen, A. Kokoshke, personal communications, 1981.

**Tree species symbols as in Appendix 2.

8.3.1 Prescriptions for ICHgl

TABLE 10.

Summary of silvicultural prescriptions and guidelines for the ICHgl

Ecosystem Unit	Prescribed Fire	Species[1] Selection			Regeneration Method	Maximum Regeneration Delay (yrs.)	Free-Growing[2] Survey (yrs. from establishment)	Minimum Leader Growth[3] (cm)	Brush Potential	Stand Tending	
		Preferred	Acceptable	Unacceptable						Brushing and Weeding	Spacing or Pre-commercial Thinning
/01 Zonal hemlock - moss	AVOID	Sx,Pl[4]	(Hw),Pl	(Hw),Cw,Bl, Ba, Sxs	Plant or natural	8	4-6	15(18)	Low		usually req'd
/02 Pine - lichen	AVOID LOGGING										
/03 Dry hemlock - moss	DO NOT BURN	Pl	Sx[5]	Hw,Bl,Ba Cw,Sxs	Plant or natural	8	4-6	15(18)	Very low		as req'd
/04 Devil's club - oak fern - feather moss	OK	Sx	Pl[6],Hw[7], (Bl)	Ba,(Bl), Cw,Sxs	Plant	2-3[8]	8-11	18(25)	Moderate	as req'd	as req'd
/05 Devil's club - fern-leafy moss	OK	Sx	Bl,Hw[7], Pl[6]	Ba,Cw, Sxs	Plant	2-3[8]	8-11	18(25)	Moderate-high	as req'd	as req'd
/06 Horsetail - (skunk cabbage) swamp	AVOID	Sx	Bl	Hw,Cw,Pl Ba,Sxs	Plant or natural	8	4-6	15	Variable	usually not req'd	as req'd
/07 Floodplain cottonwood	OK	Sx	Bl,Pl[6]	Hw,Cw, Ba,Sxs	Plant	2-3[8]	8-11	18(25)	Variable (high)[9]	REQ'D annually	

[1] Tree species symbols as in Appendix 2.

[2] Free-growing tree when last whorl is equal to or above competing vegetation.

[3] For all commercial tree species; figures for lodgepole pine only in parentheses.

[4] Lodgepole pine preferred in coarser textured soils; otherwise merely acceptable.

[5] Hybrid spruce acceptable on finer textured soils and as less than 20% of total crop trees present.

[6] Lodgepole pine acceptable on deep, well-drained, coarse textured soils, and only on short rotations -- otherwise other species will outproduce pine.

[7] Western hemlock aceptable on undisturbed surface organic matter and as less than 20% of total crop trees present.

[8] Maximum regeneration delay should be two years from initiation of harvesting unless site preparation is prescribed, in which case regeneration delay could be three years.

[9] Avoid mechanical site preparation.

ECOSYSTEM UNIT(S):	ICHg1/01	Zonal hemlock - moss
	ICHg1/01(1)	*Vaccinium* variation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, (Pl) PREFERRED	
Site Prep.	-AVOID - LIGHT BURN OK	-advanced regen. may be acceptable
Reforestation	-if required plant spruce (or Pl)	-establishment of Spruce may be hindered by the *Pineus* aphid
Brush and Weed, Spacing	-ASSESS AT TIME OF SURVIVAL EXAM	

	COMMENTS
Species Selection	-acceptable: (Hw), (Pl), (Bl to the northeast at higher elevations) -unacceptable: (Hw), Cw, Bl, Ba, Sxs
Site Prep.	
- Fire	-when humus is thicker than 10 cm or adv. regen. is unacceptable burning is OK
- Brush	-no problem unless there is a significant deciduous component in the mature stand or in adjacent areas
- MSP	-mixing of humus with mineral soil may improve site (DO NOT SCALP)
Brush and Weed	-probably unnecessary
Spacing	-usually required, particularly if adv. regen. present

ECOSYSTEM UNIT(S):

ICHg1/02	Pine - lichen
ICHg2/02	Pine - lichen
ICHg3/02	Pine - lichen
ICHg3/07	Black spruce - peat moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Logging	-AVOID	

COMMENTS

These units are submarginal for timber production.

ECOSYSTEM UNIT(S): ICHg1/03 Dry hemlock - moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Pl PREFERRED	
Logging	-LOG TO PROMOTE Pl REGEN. WHERE APPROPRIATE	-variable serotiny
Site Prep. - Fire	-DO NOT BURN	
Reforestation	-if required plant Pl	
Brush and Weed, Spacing	-as required, usually unwarranted	

COMMENTS

Logging	-if Pl is likely to restock the opening (stems/ha?, viable cone crop?) then adjust logging (method, season, size) to promote Pl. -where stand structure permits (see Sec. 8.2.1i) extract only merchantable stems and leave rest standing.
Species Selection	-acceptable: (Sx); a minor component of deciduous trees may improve site -unacceptable: Hw, Bl, Ba, Cw, (Sx), Sxs
Site Prep. - Fire	-coarse textured soils or shallow humus are particularly susceptible to degradation by fire. -if humus is greater than 15 cm thick consider a light burn to maintain or improve productivity
- Brush	-generally no problem (deciduous trees occasionally may cause some problems - mechanical control)
- MSP	-mixing of humus with mineral soil may improve site
Brush and Weed	-higher priorities elsewhere will preclude stand tending. -tight espacement at planting will probably result in need for future spacing.

ECOSYSTEM UNIT(S): ICHg1/04 Devil's club - oak fern - feather moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Site Prep. - Fire	-OK, EXCEPT ON SHALLOW SOILS	
Reforestation	-PLANT IMMEDIATELY TO SX	-spruce weevil likely to cause serious damage
Brush and Weed	-ASSESS DURING FIRST SURVIVAL ASSESSMENT	
Spacing	-ASSESS NEED AT SURVIVAL ASSESSMENT	

	COMMENTS
Species Selection	-acceptable: (Hw), (Pl - short rotations), (Bl) -unacceptable: Cw, (Hw, Pl, Bl), Ba, Sxs
Site Prep. - Fire	-unlikely to cause serious degradation. When organic horizons are thicker than 15 cm, burning may improve site productivity.
- Brush	-moderate - birch, aspen, and/or cottonwood may be problems; try mechanical control or consider "hack-and-squirt".
Spacing	-if weevil is causing serious damage favour species other than spruce.

ECOSYSTEM UNIT(S): ICHg1/05 Devil's club - fern - leafy moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE ESTABLISHMENT	-timing is critical if brush is to be controlled
Logging	-MINIMIZE DISTURBANCE OF THESE UNITS (WINTER LOG)	
Site Prep. - Fire	-OK	
Reforestation	-PLANT IMMEDIATELY WITH Sx	-plant high spots spruce weevil is likely to cause serious damage
Brush and Weed	-ASSESS NEED AND URGENCY AT TIME OF PLANTING	
Spacing	-as required	

	COMMENTS
Species Selection	-acceptable: Bl, (Hw), Pl on short rotation -unacceptable: Ba, Cw, (Hw), Sxs, Pl on long rotation (greater than 80 years)
Site Prep.	
- Fire	-may be desirable for planter access but often difficult to get an acceptable burn due to wetness of site and rapid brushing-in.
- Brush	-moderate to severe - depends on abundance in stand before logging and degree of disturbance. Birch occasionally poses a severe problem.
- MSP	-not recommended because of fine soil textures, wetness of site, and brush hazard.
Brush and Weed	-timing of treatment is a function of species, percent cover, vigour, and elevation.
Spacing	-assess need after release. -if weevil is causing serious damage, favour species other than spruce.

ECOSYSTEM UNIT(S):

ICHg1/06	Horsetail - (skunk cabbage) swamp
ICHg2/06	Horsetail swamp
ICHg3/06	Horsetail - (skunk cabbage) swamp

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Logging	-DO NOT DESTROY MOUNDS (WINTER LOG) -AVOID LOGGING POORER EXAMPLES OF THESE UNITS	 -selective logging may be a viable alternative
Site Prep. - Fire	-AVOID	-burning heavy slash likely will reduce organic horizons (i.e., productive area)
Reforestation	-FILL-PLANT (MOUNDS ONLY) WITH Sx	
Brush and Weed	-as required	
Spacing	-as required	

COMMENTS

Logging	-log in winter or driest parts of summer.

		ICHg1	ICHg2	ICHg3
Species Selection	-preferred	Sx	Sx, Cw	Sx,(Cw)
	-acceptable	Bl	(Hw)	(Pl),(Cw)
	-unacceptable	Pl,Hw,Cw, Sxs	(Hw),Bl,Pl, Ba,Sxs	Bl,Hw,Ba, (Pl)

Site Prep. - Fire	-difficult to do a good job but could be used for species conversion; consider planting chance before prescribing fire.
- Brush	-variable (depends on drainage and richness of site).
Brush and Weed, Spacing	-usually not required because of patchy stocking and open stand structure.

ECOSYSTEM UNIT(S):		
	ICHg1/07	Floodplain - cottonwood seral
	ICHg2/07	Floodplain - cottonwood seral
	ICHg3/11	Floodplain - cottonwood seral

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE "FREE GROWING" CONIFERS -PROVIDE APPROPRIATE LEAD TIME	-timing of treatments is critical
Site Prep.		
- Fire	-OK	-timing is important
- MSP	-AVOID IF POSSIBLE	
Reforestation	-PLANT Sx IMMEDIATELY (LARGE PLUG STOCK)	-spruce weevil may cause serious damage
Brush and Weed	-REQUIRED	
Spacing	-as required	-be prepared to use herbicides (hack-and-squirt at least)

	COMMENTS
Logging	-consider under-planting around conifers about 2 years before winter logging (snow protection). Lay out skid trails accordingly.
Species Selection	-consider managing for deciduous species (cottonwood and aspen). -preferred: Sx, Cw (except in ICHg1) -acceptable: Bl, (Pl may be useful as brush control - large plugs, tight espacement) -unacceptable: Hw, (Pl), (Cw in ICHg1), Sxs
Site Prep.	
- MSP	-consider MSP only in conjunction with a planned (commitment), regular, mechanical brush and weed program.
- Fire	-burning is often difficult due to poor distribution of slash and rapid brushing-in.
- Brush	-variable (severe).
Brush and Weed	-herbicides may be the only cost-efficient method to re-establish a coniferous stand.
Spacing	-usually not required.

8.3.2 Prescriptions for ICHgla

TABLE 11.

Summary of silvicultural prescriptions and guidelines for the ICHgla

Ecosystem Unit	Prescribed Fire	Species[1] Selection			Regeneration Method	Maximum Regeneration Delay (yrs.)	Free-Growing[2] Survey (yrs. from establishment)	Minimum Leader Growth[3] (cm)	Brush Potential	Stand Tending	
		Preferred	Acceptable	Unacceptable						Brushing and Weeding	Spacing or Pre-commercial Thinning
/01 Zonal hemlock - amabilis fir - (*Vaccinium*) - moss	OK	Sx	Hw,Pl,Ba[4]	Cw,Sxs	Plant or natural	8	4-6	15(18)	Low		as req'd
/02 Dry hemlock - moss	DO NOT BURN	Pl	Hw[5],Sx[6]	Cw,Ba, Sxs	Plant	8	4-6	15(18)	Very low		as req'd
/03 Devil's club - oak fern	OK	Sx	Hw,Ba, Cw[7],Pl[8]	Sxs	Plant or advance natural	2-3[9]	8-11	18(25)	Moderate	as req'd	as req'd
/04 Devil's club - lady fern - oak fern	OK	Sx	Hw,Ba, Cw[7],Pl[8]	Sxs	Plant	2-3[9]	8-11	18(25)	High	REQ'D	as req'd

[1] Tree species symbols as in Appendix 2.

[2] Free-growing tree when last whorl is equal to or above competing vegetation.

[3] For all commercial tree species; figures for lodgepole pine only in parentheses.

[4] Acceptable if ecosystem appears to be slightly richer in nutrients than average.

[5] Acceptable only on undisturbed humus and as a small percentage (less than 10%) of total plantation.

[6] Acceptable as a small percentage of the plantation on fine textured soils.

[7] Acceptable but risky; should only be a small percentage of the plantation.

[8] Acceptable on coarse, well-drained soils and on short rotations, otherwise probably will be outproduced by other species.

[9] Maximum regeneration delay should be two years from beginning of harvesting unless site preparation is prescribed, in which case regeneration delay could be three years.

ECOSYSTEM UNIT(S): ICHg1a/01 Zonal hemlock - amabilis fir - (*Vaccinium*) - moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Site Prep. - Fire	-OK; AVOID IF POSSIBLE	-protect acceptable adv. regen.
Reforestation	-UTILIZE ACCEPTABLE ADV. Hw -IF REQ'D PLANT (FILL-PLANT) WITH SPRUCE (OR Hw)	
Brush and Weed	-ASSESS NEED AT TIME OF REGEN. SURVEY	
Spacing	-USUALLY REQUIRED -ASSESS 5-10 YEARS AFTER ESTABLISHMENT	

	COMMENTS
Species Selection	-acceptable: Hw, Pl, (Ba only on moister and richer examples of these units) unacceptable: (Ba - drier units), Sxs, Cw
Site Prep. - Fire	-frequently unnecessary due to adequate advanced regen. -planting required if burned.
- Brush	-light (occasionally moderate) -*Vaccinium*, if not burned, may pose a problem to planters and initial growth of trees
Brush and Weed	-generally not required.
Spacing	-during spacing assessment be particularly critical of Ba. This species may slow down on drier, poorer, colder examples of this unit.

ECOSYSTEM UNIT(S): ICHg1a/02 Dry hemlock - moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Pl PREFERRED	
Site Prep. - Fire	-DO NOT BURN	
Reforestation	-PLANT WITH Pl	
Brush and Weed	-as required	
Spacing	-as required - generally unwarranted	

COMMENTS

Species Selection	-acceptable: (Hw), (Sx) -unacceptable: Ba, Cw, (Sx), (Hw), Sxs -a minor component of aspen or birch may improve the site by promoting decomposition and incorporation of litter into soil.
Site Prep. - Fire	-organic horizons are very beneficial for these units unless they are too thick (more than 15 cm); therefore, avoid burning. - if only the L horizon is consumed, burning is OK. - if adv. regen. is unacceptable, consider a light burn (spring).
- Brush	-no problem.
Brush and Weed, Spacing	-higher priorities elsewhere will normally preclude stand tending on these units. However, if required, eliminate true firs and reduce hemlock component as much as possible. Wider espacement than on moister ecosystems is probably desirable.

ECOSYSTEM UNIT(S): ICHgla/03 Devil's club - oak fern

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Logging	-MINIMIZE SLASH PRODUCTION	-this unit often exists in complex with /01 as hollows (which typically collect slash)
	-MINIMIZE DISTURBANCE	-logging during wetter seasons aggravates site disturbance problems (e.g., brush)
Site Prep.		
- Fire	-OK, EXCEPT ON SHALLOW SOILS	-burns must be planted
Reforestation	-UTILIZE ACCEPTABLE Hw and Ba -IF PLANTING IS REQUIRED DO SO IMMEDIATELY WITH Sx (OR Cw)	-no Ba where soil freezes
Brush and Weed	-ASSESS NEED AT TIME OF FIRST SURVIVAL ASSESSMENT	
Spacing	-PLAN FOR SPACING ASSESSMENT	

	COMMENTS
Species Selection	-acceptable: Hw, Ba, (Cw), Pl on short rotations -unacceptable: Pl on long rotations, (Cw), Sxs
Site Prep.	
- Fire	-often unnecessary due to complexing with ICHgla/01; that is, overall stocking is usually adequate. -avoid burning - on shallower soils (shallow to bedrock, pans, or water table). -plant around slash pockets to get acceptable stocking.
- Brush	-moderate to severe - depends on mature stand structure and amount of disturbance.
Brush and Weed	-as required.
Spacing	-if not burned this unit will likely require spacing.

ECOSYSTEM UNIT(S): ICHgla/04 Devil's club - lady fern - oak fern

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE ESTABLISHMENT	-timing (lead time) is critical if brush is to be controlled
Logging	-LOG DURING DRIER TIMES OF YEAR - MINIMIZE DISTURBANCE	-winter logging followed by a spring burn will save a season
Site Prep.		
- Fire	-GENERALLY OK, BUT DO NOT BURN ON FRAGMENTAL OR SKELETAL SOILS	
Reforestation	-PLANT IMMEDIATELY WITH HEALTHY, STURDY STOCK (SPRUCE).	-plant high spots
Brush and Weed	-ASSESS NEED AND URGENCY AT TIME OF PLANTING	
Spacing	-as required	

	COMMENTS
Species Selection	-acceptable: Hw, Ba, Cw, Pl on short rotation -unacceptable: Sxs, Pl on long rotation (80-plus years)
Site Prep.	
- Fire	-difficult to get an acceptable burn due to wetness of site and rapid brushing-in.
- Brush	-usually severe - plan everything to minimize this problem.
- MSP	-not recommended because of fine soil textures or wetness of site or brush hazards.
Brush and Weed	-release will be required - the sooner the better, but timing is a function of species, percent cover, vigour, and elevation.
Spacing	-assess need after release.

8.3.3 Prescriptions for ICHg2

TABLE 12.

Summary of silvicultural prescriptions and guidelines for the ICHg2

Ecosystem Unit	Prescribed Fire	Species[1] Selection			Regeneration Method	Maximum Regeneration Delay (yrs.)	Free-Growing[2] Survey (yrs. from establishment)	Minimum Leader Growth[3] (cm)	Brush Potential	Stand Tending	
		Preferred	Acceptable	Unacceptable						Brushing and Weeding	Spacing or Pre-commercial Thinning
/01 Zonal hemlock - (cedar) - moss	AVOID	Sx	Pl,Hw[4], Cw[5]	Bl,Ba Sxs	Plant	8	4-6	15(18)	Low		usually req'd
/02 Pine - lichen	AVOID LOGGING										
/03 Dry hemlock - moss	DO NOT BURN	Pl	Sx[6]	Hw,Bl,Ba, Cw,Sxs	Plant or natural	8	4-6	15(18)	Very Low		as req'd
/04 Devil's club - oak fern - feather moss	OK	Sx	Cw,Hw Pl,Ba[7], Bl[7]	Sxs	Plant or natural	8	4-6	15(18)	Variable	as req'd	as req'd
/05 Devil's club - fern - leafy moss	OK	Sx,Cw	Bl[7],Ba[7] Hw,Pl[8]	Sxs	Plant	2-3[9]	8-11	18(25)	Variable (high)	REQ'D	as req'd
/06 Horsetail swamp	AVOID	Sx,Cw	Hw[10]	Bl,Pl Ba,Sxs	Plant or natural	8	4-6	15	Variable	usually not req'd	
/07 Floodplain cottonwood	OK	Sx,Cw	Bl,Pl[8]	Hw,Ba,Sxs	Plant	2-3[9]	8-11	18(25)	High[11]	REQ'D	

[1] Tree species symbols as in Appendix 2.

[2] Free-growing tree when last whorl is equal to or above competing vegetation.

[3] For all commercial tree species; figures for lodgepole pine in parentheses.

[4] On undisturbed humus.

[5] As a secondary species only (less than 20% of total crop trees present).

[6] On finer textured soils and as a secondary species.

[7] Amabilis fir acceptable at high elevations in western portions of the variant; subalpine fir in northeastern portions.

[8] On short rotations, and on deep, well-drained, coarse-textured soils.

[9] Maximum regeneration delay should be two years from initiation of harvesting unless site preparation is prescribed, in which case regeneration delay could be three years.

[10] On drier hummocks of undisturbed forest floors.

[11] Avoid mechanical site preparation.

ECOSYSTEM UNIT(S): ICHg2/01 Zonal hemlock - (cedar) - moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Site Prep. - Fire	-AVOID - LIGHT BURN OK	
Reforestation	-PLANT Sx OR Pl	-establishment of spruce may be hindered by Pineus aphid
Brush and Weed, Spacing	-ASSESS NEED DURING SURVIVAL EXAM	

	COMMENTS
Species Selection	-acceptable: Pl, (Hw, Cw); Hw becomes acceptable at higher elevations and on northern aspects; Cw on moister, richer examples of this unit. -unacceptable: true firs, (Hw, Cw), Sxs
Site Prep. - Fire	-OK on deep humus (thicker than 15 cm). -go for naturals. -light burn may be desired to eliminate unacceptable advanced regeneration.
- Brush	-low; somewhat more of a problem on disturbed sites.
Brush and Weed	-probably not required. When Vaccinium species dominate, planter access and seedling establishment will be hampered.
Spacing	-low priority - plan as required by District objectives.

ECOSYSTEM UNIT(S):		
	ICHg1/02	Pine - lichen
	ICHg2/02	Pine - lichen
	ICHg3/02	Pine - lichen
	ICHg3/07	Black spruce - peat moss

ACTIVITY	PRESCRIPTION	CAUTIONS
LOGGING	-AVOID	

COMMENTS

These units are submarginal for timber production.

ECOSYSTEM UNIT(S): ICHg2/03 Dry hemlock - moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Pl PREFERRED	
Logging	-PROMOTE Pl REGEN.	-variable serotiny in Pl cones
Site Prep.		
- Fire	-DO NOT BURN	
- MSP	-AVOID	
Reforestation	-if required, plant Pl	
Brush and Weed	-as required	
Spacing	-as required, usually unwarranted	

COMMENTS

Logging	-if Pl is likely to restock the opening (stems/ha, seed viability), then adjust logging to promote Pl.
Species Selection	-acceptable: (Sx), A minor component of deciduous trees -unacceptable: Hw, Bl, Cw (Sx), Sxs
Site Prep.	
- Fire	-organic horizons are very beneficial; consider removing unacceptable advanced regeneration during spacing (otherwise, if only L horizon is consumed, a light burn (spring) is acceptable).
- Brush	-low.
Spacing	-higher priorities elsewhere will normally preclude spacing on these ecosystems. -tight espacement at planting will result in future need for spacing.

ECOSYSTEM UNIT(S): ICHg2/04 Devil's club - oak fern - feather moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, (Cw) PREFERRED	
Logging		-compaction on fine textured soils
Site Prep.		
- Fire	-OK, EXCEPT IN SHALLOW SOIL	
Reforestation	-PLANT Sx (MINOR Cw)	-frost heaving on fine textured soils
Brush and Weed, Spacing	-as required - assess need during first survival exam	

	COMMENTS
Species Selection	-acceptable: Hw, Pl, Cw, Ba at high elevations in west, Bl toward northeast -unacceptable: Ba in east, Bl in west, Sxs
Site Prep.	
- Fire	-unlikely to cause serious site degradation. When organic horizons are thicker than 15 cm, burning may improve site productivity.
- Brush	-variable (generally moderate); can be serious on skid trails.
Brush and Weed	-probably unnecessary.
Spacing	-usually required, especially if adv. regen. is used as a stand component.

ECOSYSTEM UNIT(S): ICHg2/05 Devil's club - fern - leafy moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, Cw PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE ESTABLISHMENT	-timing (lead time) is critical if brush is to be controlled
Logging	-MINIMIZE DISTURBANCE OF THESE UNITS	-compaction -aggravation of brush hazard
Site Prep.		
- Fire	-OK	
Reforestation	-PLANT Sx OR Cw IMMEDIATELY	-drier examples - frost heaving -wetter examples - plant high spots
Brush and Weed	-ASSESS NEED AND URGENCY AT TIME OF PLANTING	
Spacing	-as required	

	COMMENTS
Logging	-winter is preferred (snow and frozen ground).
Species Selection	-acceptable: Bl, Hw, Pl on short rotation (At higher elevations true firs and Hw may be preferable) -unacceptable: Pl on long rotations (80+ years), Sxs.
Site Prep.	
- Fire	-often difficult to get an acceptable burn due to wetness of site and brushing-in.
- Brush	-variable (moderate-severe); disturbance increases the deciduous component.
- MSP	-not recommended because of fine soil textures and wetness of site.
Brush and Weed	-timing of treatment is a function of species, percent cover, vigour, and elevation.
Spacing	-assess need after a successful brush and weeding program.

ECOSYSTEM UNIT(S):	ICHg1/06	Horsetail - (skunk cabbage) swamp
	ICHg2/06	Horsetail swamp
	ICHg3/06	Horsetail - (skunk cabbage) swamp

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, Cw PREFERRED	
Logging	-DO NOT DESTROY MOUNDS (WINTER LOG)	
	-AVOID LOGGING POORER EXAMPLES OF THESE UNITS	-selective logging may be a viable alternative
Site Prep. - Fire	-AVOID	
Reforestation	-FILL PLANT (MOUNDS ONLY) WITH Sx	
Brush and Weed, Spacing	-as required	

COMMENTS

Logging -log in winter or driest parts of summer.

Species Selection

	ICHg1	ICHg2	ICHg3
-preferred	Sx	Sx, Cw	Sx, (Cw)
acceptable	Bl	(Hw)	(Pl), (Cw)
unacceptable	Pl, Hw, Cw Sxs	(Hw), Bl Pl, Ba, Sxs	Bl, Hw, Ba Sxs, (Pl)

Site Prep.

- Fire -difficult to do a good job but could be used for species conversion; consider planting chance before prescribing fire.

- Brush -variable (depends on drainage and richness of site).

Brush and Weed, Spacing -usually not required because of patchy stocking and open stand structure.

ECOSYSTEM UNIT(S):		
	ICHg1/07	Floodplain - cottonwood seral
	ICHg2/07	Floodplain - cottonwood seral
	ICHg3/11	Floodplain - cottonwood seral

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, Cw PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE "FREE GROWING" CONIFERS -PROVIDE APPROPRIATE LEAD TIME	-timing of treatments is critical
Site Prep.		
- Fire	-OK	-timing is important
- MSP	-AVOID IF POSSIBLE	
Reforestation	-PLANT Sx IMMEDIATELY (LARGE PLUG STOCK)	-spruce weevil may cause serious damage
Brush and Weed	-REQUIRED	
Spacing	-as required	-be prepared to use herbicides (hack-and-squirt at least.)

	COMMENTS
Logging	-consider under-planting around conifers about 2 years before winter logging (snow protection). Lay out skid trails accordingly.
Species Selection	-consider managing for deciduous species (cottonwood and aspen) -preferred: Sx, Cw (except in ICHg1) -acceptable: Bl, (Pl may be useful as brush control) (large plugs, tight espacement) -unacceptable: Hw, (Pl), (Cw in ICHg1), Sxs
Site Prep.	
- MSP	-consider MSP only in conjunction with a planned (commitment) regular mechanical brush and weed program.
- Fire	-burning is often difficult due to poor distribution of slash and rapid brushing-in.
- Brush	-variable (severe).
Brush and Weed	-herbicides may be the only cost-efficient method to re-establish a coniferous stand.
Spacing	-usually not required.

8.3.4 Prescriptions for ICHg3

TABLE 13.

Summary of silvicultural prescriptions and guidelines for the ICHg3

Ecosystem Unit	Prescribed Fire	Species[1] Selection			Regeneration Method	Maximum Regeneration Delay (yrs.)	Free-Growing[2] Survey (yrs. from establishment)	Minimum Leader Growth[3] (cm)	Brush Potential	Stand Tending	
		Preferred	Acceptable	Unacceptable						Brushing and Weeding	Spacing or Pre-commercial Thinning
/01.1 Zonal hemlock - moss, Hemlock - (cedar) subassociation	AVOID	Sx[4],Pl[5]	Hw[6],Sx Pl	Bl,Sxs Cw	Plant or natural	8	4-6	15(18)	Low	as req'd	usually req'd
/01.2 Zonal hemlock - moss, Subalpine fir - spruce subassociation	AVOID	Sx[4],Pl[5]	Sx,Pl, Bl	Hw,Cw, Sxs	Plant or natural	8	4-6	15(18)	Variable	as req'd	
/02 Pine - lichen	AVOID LOGGING										
/03 Dry hemlock - moss	DO NOT BURN	Pl	Sx[7]	Hw,Cw, Bl,Sxs	Plant or natural	8	4-6	15(18)	Very Low		as req'd
/04.1 Devil's club - oak fern, Hemlock - cedar subassociation	OK	Sx	Cw,Hw[8], Pl[9]	Bl,Sxs	Plant	2-3[10]	8-11	18(25)	Variable	as req'd	REQ'D
/04.2 Devil's club - oak fern, Spruce - subalpine fir subassociation	OK	Sx	Bl,Pl, Cw[11]	Hw	Plant	2-3[10]	8-11	18(25)	Moderate	as req'd	REQ'D
/05 Devil's club - fern - leafy moss	OK	Sx	Pl,Bl[12] Cw[12]	Hw, Sxs	Plant	2-3[10]	8-11	18(25)	High	REQ'D	as req'd
/06 Horsetail - (skunk cabbage) swamp	AVOID	Sx,Cw[12]	Cw,Pl[13]	Hw, Bl,Sxs	Plant or natural	8	4-6	15(18)	Variable	usually not req'd	REQ'D
/07 Black spruce - peat moss	AVOID LOGGING										

TABLE 13. (cont'd)

Ecosystem Unit	Prescribed Fire	Species[1] Selection			Regeneration Method	Maximum Regeneration Delay (yrs.)	Free-Growing[2] Survey (yrs. from establishment)	Minimum Leader Growth[3] (cm)	Brush Potential	Stand Tending	
		Preferred	Acceptable	Unacceptable						Brushing and Weeding	Spacing or Pre-commercial Thinning
/08 Pine - soopolallie	DO NOT BURN	Pl	Sx[7]	Hw,Cw, Bl,Sxs	Plant or natural	8	4-6	15(18)	Low		REQ'D
/09(a) Spruce-pine - shrub: Coarse textured phase	DO NOT BURN	Pl	Sx[7]	Hw,Cw, Bl,Sxs	Plant or natural	8	4-6	15(18)	Low		REQ'D
/09(b) Spruce-pine - shrub: Fine textured phase	AVOID	Sx	Pl,Bl Cw[12]	Hw, Sxs	Plant	2-3[10]	8-11	15(18)	Variable	as req'd	as req'd
/10 Aspen - birch - red osier dogwood	NO COMMERCIAL TIMBER VALUES										
/11 Floodplain cottonwood	OK	Sx,Cw	Bl,Pl[13]	Hw,Sxs	Plant	2-3[10]	8-11	18(25)	Variable (high)[14]	REQ'D	as req'd

[1] Tree species symbols as in Appendix 2.
[2] Free-growing tree when last whorl is equal to or above competing vegetation.
[3] For all commercial tree species; figures for lodgepole pine only in parentheses.
[4] On fine textured phase.
[5] On coarse textured phase.
[6] Acceptable only on fine textured phase on north slopes and as less than 20% of total crop trees present.
[7] On finer textured soils as a small component of the stand.
[8] On organic matter thicker than 15cm and as less than 20% of total trees present.
[9] On short rotations.
[10] Maximum regeneration delay should be two years from initiation of harvesting unless site preparation is prescribed, in which case regeneration delay could be three years.
[11] Where seepage and mottling occur within 60 cm of the soil surface.
[12] As a secondary species (less than 50% of the stand).
[13] On deep, coarse, well-drained soil with minimum risk of flooding (no mottles within 30 cm of soil surface).
[14] Avoid mechanical site preparation.

ECOSYSTEM UNIT(S): ICHg3/01.1 Zonal hemlock - moss, Hemlock - (cedar) subassociation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-(Sx), (Pl) PREFERRED	
Site Prep.		
- Fire	-AVOID - LIGHT BURN OK	
- MSP	-OK	
Reforestation	-PLANT Sx OR Pl	-late frosts and dry spring
Brush and Weed, Spacing	-as required	-establishment of spruce will be hindered by the *Pineus* aphid

	COMMENTS
Species Selection	-acceptable: (Hw on fine textured phase on north slopes), (Sxw), (Pl) -unacceptable: (Hw), Bl, Ba, Sxs, Cw
Site Prep.	
- Fire	-organic horizons are beneficial; therefore, avoid burning. -if only L horizon is consumed, burning is OK.
- Brush	-light; severity of problem is a function of the number of deciduous trees in the stand.
Brush and Weed	-if required, one or two mechanical treatments should do.
Spacing	-as required; if using adv. regen., assess for spacing at time of regen. survey (decrease Hw component).

ECOSYSTEM UNIT(S):	ICHg3/01.2	Zonal hemlock - moss, Subalpine fir - spruce subassociation
	ICHg3/09(b)	Spruce - pine - shrub seral: Fine textured phase

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, (Pl) PREFERRED	
Logging		-possible soil compaction on fine textured soils
Site Prep.		
- Fire	-AVOID: LIGHT BURN OK	
- MSP	-OK BUT DO NOT SCALP	-fine textured soils susceptible to heaving and compaction
Reforestation	-PLANT Sx OR Pl	-plant on mounds rather than in depressions or gouges -late frosts and dry springs
Brush and Weed, Spacing	-as required - assess need during survival exam.	

	COMMENTS
Species Selection	-acceptable: (Pl), (Bl), (Cw) -unacceptable: Hw, (Cw), (Bl), Sxs
Site Prep.	
- Fire	-without a signficant Ah (thicker than 3 cm), burn should not consume more than litter (L) layer.
- MSP	-drag equipment (vs. scraping or scalping) should be sufficient to provide planter access.
- Brush	-variable; will be aggravated by disturbance. -if birch or aspen presents a particular problem consider hack-and-squirt before logging.

ECOSYSTEM UNIT(S):		
	ICHg1/02	Pine - lichen
	ICHg2/02	Pine - lichen
	ICHg3/02	Pine - lichen
	ICHg3/07	Black spruce - peat moss

ACTIVITY	PRESCRIPTION	CAUTIONS
LOGGING	-AVOID	

COMMENTS

These units are submarginal for timber production.

ECOSYSTEM UNIT(S):		
	ICHg3/03(a)	Dry hemlock - moss: Lithic phase
	ICHg3/03(b)	Dry hemlock - moss: Coarse textured phase
	ICHg3/08	Pine - soopolallie seral
	ICHg3/09(a)	Spruce - pine - shrub seral: Coarse textured phase

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Pl PREFERRED	
Logging	-PROMOTE Pl REGEN.	-variable serotiny in Pl cones
Site Prep.		
- Fire	-DO NOT BURN	
- MSP	-AVOID	
Reforestation	-if required plant Pl; minor Sx is OK	-Sx will be infested by Pineus aphid
Brush and Weed	-as required	
Spacing	-as required, usually unwarranted	

	COMMENTS
Logging	-if Pl is likely to restock the opening (stems/ha?, viable cone crop?) then adjust logging (method, season, opening size) to promote Pl.
Species Selection	-acceptable: (Sx), a minor component of deciduous trees -unacceptable: Hw, Bl, Cw, Sxs, (Sx)
Site Prep.	
- Fire	-organic horizons are very beneficial; consider removing unacceptable adv. regen. at spacing (Otherwise, if only L horizon is consumed, a light burn (spring) is acceptable).
- Brush	-nil to low in seral stands.
- MSP	-occasionally OK but do not scalp; humus horizons are very beneficial on these units.
Brush and Weed	-probably unnecessary but if required use mechanical means.
Spacing	-higher priorities elsewhere will normally preclude spacing on these units. -tight espacement at planting will result in future need for spacing.

ECOSYSTEM UNIT(S): ICHg3/04.1 Devil's club - oak fern - feather moss, Hemlock - cedar subassociation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Logging	-PROMOTE Pl REGEN.	-compaction on fine textured soils
Site Prep.		
- Fire	-OK (use with care)	-frost heaving
- MSP	-OK	-aggravates brush and compaction problems
Reforestation	-PLANT IMMEDIATELY WITH Sx	-late frosts and dry springs
Brush and Weed	-ASSESS NEED DURING FIRST SURVIVAL ASSESSMENT	
Spacing	-as required	

	COMMENTS
Species Selection	-acceptable: (Pl), Cw, (Hw), Sxw -unacceptable: (Hw), Bl, Sxs, (Pl)
Site Prep.	
- Fire	-without a significant Ah (thicker than 3 cm), burn should not consume more than litter (L) layer.
- Brush	-variable (moderate to severe); depends on presence in mature stand.
Brush and Weed	-when required; herbicides (hack-and-squirt) may be better alternative.

ECOSYSTEM UNIT(S): ICHg3/04.2 Devil's club - oak fern - feather moss, Spruce - subalpine fir subassociation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Logging		-soil compaction on fine textured soils
Site Prep.		
- Fire	-OK (use with care)	
- MSP	-OK	-aggravates brush problem -fine textured soils susceptible to frost heaving
Reforestation	-PLANT Sx OR Pl	-late frost and dry springs -plant in mounds rather than in depressions or gouges (because of cold air ponding)
Brush and Weed	-ASSESS AT TIME OF FIRST SURVIVAL ASSESSMENT	
Spacing	-as required	

	COMMENTS
Logging	-winter is preferred (if summer, use wide-tracked vehicles or yard during dry periods)
Species Selection	-acceptable: Pl, Bl, Sxw, (Cw) -unacceptable: Hw, (Cw), Sxs
Site Prep.	
- Fire	-without a significant Ah horizon (thicker than 3 cm), burn should consume no more than litter (L) layer.
- Brush	-moderate (occasionally severe).
- MSP	-often a good alternative to burning. Drag equipment (vs. scraping or scalping equip.) should be sufficient to provide planter access.
Brush and Weed	-as required. Mechanical control (2 or 3 treatments) may be sufficent.

ECOSYSTEM UNIT(S): ICHg3/05 Devil's club - fern - leafy moss

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE ESTABLISHMENT	-timing (lead time) is critical if brush is to be controlled.
Logging	-MINIMIZE DISTURBANCE	-aggravation of brush hazard
Site Prep. - Fire	-OK	
Reforestation	-PLANT Sx IMMEDIATELY (WITH MINOR Cw)	-late frosts and dry springs
Brush and Weed	-ASSESS NEED AND URGENCY AT TIME OF PLANTING	
Spacing	-as required	

	COMMENTS
Logging	-winter is preferred (snow and frozen ground).
Species Selection	-acceptable: Sxw, Pl, (Bl), (Cw) -unacceptable: Sxs, Hw, (Bl), (Cw), Ba
Site Prep. - Fire	-unlikely to cause serious site degradation.
- Brush	-severe, particularly if disturbed.
- MSP	-not recommended because of fine soil textures or wetness of site or brush invasion.
Brush and Weed	-timing of treatment is a function of species, percent cover, vigour, and elevation.
Spacing	-assess need after a successful brushing and weeding program.

ECOSYSTEM UNIT(S):		
	ICHg1/06	Horsetail - (skunk cabbage) swamp
	ICHg2/06	Horsetail swamp
	ICHg3/06	Horsetail - (skunk cabbage) swamp

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, (Cw) PREFERRED	
Logging	-DO NOT DESTROY MOUNDS (WINTER LOG)	
	-AVOID LOGGING POORER EXAMPLES OF THESE UNITS	-selective logging may be a viable alternative
Site Prep. - Fire	-AVOID	
Reforestation	-FILL-PLANT (MOUNDS ONLY) WITH Sx	
Brush and Weed, Spacing	-as required	

COMMENTS

Logging -log in winter or driest parts of summer.

Species Selection

	ICHg1	ICHg2	ICHg3
-preferred	Sx	Sx, Cw	Sx, (Cw)
acceptable	Bl	(Hw)	(Pl), (Cw)
unacceptable	Pl ,Hw,Cw Sxs	(Hw), Bl, Pl Ba, Sxs	Bl, Hw, Ba (Pl), Sxs

Site Prep.
- Fire -difficult to do a good job but could be used for species conversion; consider planting chance before prescribing fire.
- Brush -variable (depends on drainage and richness of site).

Brush and Weed, Spacing -usually not required because of patchy stocking and open stand structure

ECOSYSTEM UNIT(S): ICHg3/10 Aspen - birch - red-osier dogwood seral
ICHg3/10(a) Hazelnut fluvial phase

ACTIVITY	PRESCRIPTION	CAUTIONS

COMMENTS

These units have little timber value at present. Rehabilitation to produce a conifer stand is very costly. Therefore activity in these units should be restricted to firewood cutting until effective methods of conversion are employed (e.g., herbicides).

ECOSYSTEM UNIT(S):	ICHg1/07	Floodplain - cottonwood seral
	ICHg2/07	Floodplain - cottonwood seral
	ICHg3/11	Floodplain - cottonwood seral

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	-Sx, Cw PREFERRED	
Treatment Plan	-PLAN ALL TREATMENTS NECESSARY TO ENSURE "FREE GROWING" CONIFERS -PROVIDE APPROPRIATE LEAD TIME	-timing of treatments is critical
Site Preparation		
- Fire	-OK	-timing is important
- MSP	AVOID IF POSSIBLE	
Reforestation	-PLANT Sx IMMEDIATELY (LARGE PLUG STOCK)	-spruce weevil may cause serious damage
Brush and Weed	-REQUIRED	
Spacing	-as required	-be prepared to use herbicides (hack and squirt at least)

	COMMENTS
Logging	-consider under-planting around conifers about 2 years before winter logging (snow protection). Lay out skid trails accordingly.
Species Selection	-consider managing for deciduous species (cottonwood and aspen) preferred: Sx, Cw (except in ICHg1) acceptable: Bl, (Pl may be useful as brush control) (large plugs, tight espacement) unacceptable: Hw, (Pl), (Cw in ICHg1), Sxs
Site Prep.	
- MSP	-consider MSP only in conjunction with a planned (commitment), regular, mechanical brush and weed program.
- Fire	-burning is often difficult due to poor distribution of slash and rapid brushing-in.
- Brush	-variable (severe).
Brush and Weed	-herbicides may be the only cost-efficient method to re-establish a coniferous stand.
Spacing	-usually not required.

8.3.5 Prescriptions for the ICHg4.

Environmental characteristics of the ICHg4 (relative to the ICHgl) that influence silvicultural prescriptions are:

- more relief and wetter climate = wetter, richer ecosystems more extensive = more extensive brush problems
- much more snow (depth and duration) = slides, nonforested patches = regeneration problems
- milder climate = no summer droughts = less Pl, more Bl
- shorter growing season

Logging: Several options can be considered: 1) No logging; 2) Extraction with reforestation left to nature and chance (timber mining); 3) Logging for the cost of stand re-establishment; 4) Logging as part of rehabilitation. We think that the third option is most desirable overall, if logging is done at all in this variant. Consider selective logging around non-forested patches or slides within an opening.

Ecosystem Identification: Until more information is available, use the descriptions provided in this report for comparable ecosystem associations in the ICHgl. There will be discrepancies between these descriptions and what occurs in parallel ecosystems of the ICHg4, but field identification of ecosystems should still be possible.

	Species Selection: Ecosystem associations (preliminary) of ICHg4	Preferred	Acceptable	Unacceptable
/01	Zonal Hw - Bl - *Vaccinium* - moss	Sx	Bl, Hm[16], Hw[17]	Hw,[17] Pl, Cw
/02	Dry Hw - moss	Pl[18]	Hm[16], Hw[17]	Bl, Sx, Hw[17], Cw
/03	Devil's club - oak fern - feather moss	Sx	Bl, Act	Pl, Hw[17]
/04	Devil's club - fern - leafy moss	Sx	Bl, Act	Pl, Hw[17]
/05	Horsetail	Sx	Bl,	Pl, Hw
/06	Floodplain cottonwood	Sx	Bl, Act	Pl, Hw

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[16] Mountain hemlock is probably acceptable but will still grow relatively slowly compared to subalpine fir or hybrid spruce.

[17] Western hemlock is acceptable on hillslopes or broad ridgecrests, but will probably be under climatic stress in all ecosystems of the ICHg4.

[18] Lodgepole pine is found in the ICHg4 only on southern exposures in dry ecosystems. It is probably unacceptable in other ecosystems because of the heavy snowload.

Site Preparation: Burning is acceptable in the ICHg4/03,/04,/06, and /01, but if possible should be avoided in the ICHg4/05. Do not burn in the ICHg4/02. Winter logging is preferable in the ICHg4/04, /05, and /06.

Brush Hazard: Moderate to severe in the ICHg4/04,/05, and /06. Prompt reforestation with large healthy stock in the spring after winter logging or in the fall after burning will be advantageous.

Common Brush Species: Cottonwood, Sitka alder, red-osier dogwood, willows, thimbleberry, red elderberry, lady fern, bracken, cow-parsnip, devil's club, (salmonberry), (*Vaccinium* spp.).

Reforestation: Where possible promote advanced regeneration in the ICHg4/01 and /02. Plant bare root stock on silty and fine sandy soils. Plug stock will be acceptable in all other circumstances.

Spacing: Generally required. Note: stands tend to be patchy.

Collecting and Producing Subalpine Fir Cones and Seedlings:

1. A lot of cones must be collected due to the low yield of viable seeds.
2. Cones must be dried out quickly because there is a high risk of mould colonization.
3. Cones would have to be shipped to Koksilah shortly after picking.
4. Coastal nurseries may be inappropriate for producing such northern provenances (see Roche 1969) and thus production would be limited to northern nurseries. Red Rock may or may not be appropriate. Summers are much hotter in this nursery compared with the ICHg4. For this reason seedlings may be subjected to too much stress when considering bare root stock.
5. A north western nursery such as Thornhill would be the most appropriate; however, this nursery is limited to plug production. Plugs are not the most desirable stock type on finer textured soils.
6. Cone crops may be very irregular and thus it will be difficult to collect seed for the short term.
7. Comments 4, 5 and 6 apply to hybrid spruce as well.

In view of these comments it is clear that reforestation will be an expensive proposition.

Other Regeneration Opportunities: In order to rely on seeding-in of clearcuts, small or narrow openings are required - 50 to 70 m between opposing timber margins. Long regeneration delays must be accepted due to irregular cone crops and low seed viability.

Such delays are unacceptable for ICHg4/04 and /06. Black cottonwood may be the only logical species choice for these ecosystems. It is probably reasonable to suggest that in 30 to 40 years this will be a marketable species. In order for this option to work scions would be cut, treated with a root growth hormone, and grown in a nursery before transplantation into the field. This would be unnecessary if a viable seed source is nearby. Disturbance in the ICHg4/04 and /06 would help to successfully establish black cottonwood.

Remaining Options: The quality of timber in the ICHg4 precludes selection reproduction methods unless timber mining is accepted. However, if we cannot adequately regenerate second-growth stands then perhaps the original stand should not be logged at all.

The obstacles to successful management at this stage are:
1. The large distance from the nearest processing facilities.
2. A declining end product value due to the spruce bark beetle infestation - time is against profitable logging.
3. Large distance from seed processing facilities and bare root nursery capacity.
4. A marginal understanding of how the environmental factors affect successful reforestation.

The solution to these problems may be to do any combination of the following:
1. Develop a wood processing centre at Stewart.
2. Process wood at the landing and ship it from Stewart.
3. Develop seed processing facilities and bareroot nursery capacity near Terrace.
4. Don't log and exclude the area from the current annual allowable cut.
5. Treat the area as a large rehabilitation project taking funds from other areas to pay for reforestation.
6. Allow operators to log for the cost of successful stand establishment.
7. Improve our understanding of how the environmental factors affect successful reforestation through the ecosystem classification program.

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APPENDIX 1

List of Plant Names Used in the Guide

Trees:

Abies amabilis	amabilis fir
Abies lasiocarpa	subalpine fir
Alnus rubra	red alder
Betula papyrifera	paper birch
Juniperus scopulorum	Rocky Mountain juniper
Picea engelmannii	Engelmann spruce
Picea glauca	white spruce
Picea mariana	black spruce
Picea sitchensis	Sitka spruce
Picea glauca x *sitchensis* ? x *engelmannii*	hybrid spruce
Pinus contorta	lodgepole pine
Populus balsamifera ssp. *trichocarpa*	black cottonwood
Populus tremuloides	trembling aspen
Thuja plicata	western redcedar
Tsuga heterophylla	western hemlock
Tsuga mertensiana	mountain hemlock

Shrubs:

Acer glabrum	Douglas maple
Alnus incana ssp. *tenuifolia*	mountain alder
Alnus viridis ssp. *sinuata*	Sitka alder
Amelanchier alnifolia	Saskatoon
Betula glandulosa	scrub birch
Cornus sericea	red-osier dogwood
Corylus cornuta	hazelnut
Kalmia microphylla	bog-laurel
Ledum groenlandicum	Labrador tea
Lonicera involucrata	black twinberry
Menziesia ferruginea	false azalea
Oplopanax horridus	devil's club
Paxistima myrsinites	falsebox
Ribes lacustre	black gooseberry
Ribes spp.	gooseberries and currants
Rosa acicularis	prickly rose
Rosa nutkana	Nootka rose
Rubus idaeus	red raspberry
Rubus parviflorus	thimbleberry
Rubus spectabilis	salmonberry
Salix scouleriana	Scouler's willow
Salix spp.	willows
Sambucus racemosa	red elderberry
Shepherdia canadensis	soopolallie
Spiraea douglasii	hardhack
Symphoricarpos albus	common snowberry
Vaccinium alaskaense	Alaskan blueberry
Vaccinium membranaceum	black huckleberry
Vaccinium ovalifolium	oval-leaved blueberry
Vaccinium parvifolium	red huckleberry
Viburnum edule	highbush-cranberry

APPENDIX 1 (cont'd)

Herbs: (incudes dwarf shrubs)

Actaea rubra	baneberry
Andromeda polifolia	bog rosemary
Aralia nudicaulis	wild sarsaparilla
Arctostaphylos uva-ursi	kinnikinnick
Arnica cordifolia	heart-leaved arnica
Artemesia arctica	mountain sage
Aruncus dioicus	goat's-beard
Athyrium filix-femina	lady fern
Calamagrostis canadensis	bluejoint
Carex disperma	soft-leaved sedge
Carex spp.	sedges
Cassiope mertensiana	white mountain-heather
Chimaphila umbellata	prince's pine
Cinna latifolia	nodding wood-reed
Circaea alpina	enchanter's nightshade
Clintonia uniflora	queen's cup
Cornus canadensis	bunchberry
Drosera rotundifolia	round-leaved sundew
Dryopteris assimilis	spiny wood fern
Elymus glaucus	blue wildrye
Epilobium angustifolium	fireweed
Equisetum arvense	common horsetail
Equisetum fluviatile	swamp horsetail
Equisetum pratense	meadow horsetail
Equisetum sylvaticum	wood horsetail
Festuca occidentalis	western fescue
Fragaria virginiana	wild strawberry
Galium boreale	northern bedstraw
Galium triflorum	sweet-scented bedstraw
Gaultheria hispidula	creeping-snowberry
Goodyera oblongifolia	rattlesnake-plantain
Gymnocarpium dryopteris	oak fern
Heracleum sphondylium	cow-parsnip
Hieracium albiflorum	white-flowered hawkweed
Hypopitys monotropa	pinesap
Lathyrus nevadensis	purple peavine
Linnaea borealis	twinflower
Listera cordata	heart-leaved twayblade
Lycopodium annotinum	stiff club-moss
Lysichiton americanum	skunk cabbage
Melampyrum lineare	narrow-leaved cow-wheat
Menyanthes trifoliata	buckbean
Mitella nuda	common mitrewort
Moneses uniflora	single delight
Orthilia secunda	one-sided wintergreen
Oryzopsis asperifolia	rough-leaved ricegrass
Oryzopsis pungens	short-awned ricegrass
Osmorhiza chilensis	mountain sweet-cicely
Paxistima myrsinites	falsebox

APPENDIX 1 (cont'd)

Herbs (Cont'd) ...

Petasites palmatus	palmate colt's-foot
Phyllodoce empetriformis	pink mountain-heather
Platanthera dilatata	white bog-orchid
Platanthera orbiculata	round-leaved rein-orchid
Potentilla palustris	marsh cinquefoil
Pteridium aqilinum	bracken
Pyrola asarifolia	pink wintergreen
Pyrola chlorantha	green wintergreen
Rubus chamaemorus	cloudberry
Rubus pedatus	five-leaved bramble
Rubus pubescens	trailing raspberry
Sanicula marilandica	black snake-root
Senecio triangularis	arrowleaved groundsel
Smilacina racemosa	false Solomon's-seal
Smilacina stellata	star-flowered false Solomon's-seal
Streptopus amplexifolius	clasping twistedstalk
Streptopus roseus	rosy twistedstalk
Streptopus streptopoides	small twistedstalk
Tiarella trifoliata	three-leaved foamflower
Tiarella unifoliata	one-leaved foamflower
Vaccinium caespitosum	dwarf blueberry
Vaccinium oxycoccos	bog cranberry
Valeriana sitchensis	Sitka valerian
Veratrum viride	Indian hellebore
Viola palustris	marsh violet
Viola spp.	violets

Moss Layer: (includes lichens and liverworts)

Aulacomnium palustre	ribbed bog moss
Barbilophozia spp.	leafy liverworts
Brachythecium spp.	mosses
Calliergon spp.	mosses
Cladina spp.	reindeer lichens
Cladonia spp.	lichens
Dicranum polysetum	moss
Hylocomium splendens	step moss
Hypnum circinale	moss
Marchantia polymorpha	thalloid liverwort
Mnium spp.	leafy mosses
Pellia neesiana	thalloid liverwort
Peltigera spp.	lichen
Plagiochila porelloides	leafy liverwort
Pleurozium schreberi	red-stemmed feather moss
Polytrichum juniperinum	juniper haircap moss
Ptilium crista-castrensis	knight's plume
Rhacomitrium spp.	mosses
Rhytidiadelphus loreus	little shaggy moss
Rhytidiadelphus triquetrus	electrified cat's-tail moss
Rhytidiopsis robusta	pipecleaner moss
Scapania bolanderi	leafy liverwort
Sphagnum spp.	peat mosses

APPENDIX 2

List of Tree Species Symbols Used in the Guide

Genus	Species/Hybrid	Genus Symbol	Species or Hybrid Symbol	Subspecies or Variety Symbol
Alder		D		
Alnus	Red alder (*A. rubra*)		Dr	
Balsam or Fir		B		
Abies	Amabilis fir (*A. amabilis*)		Ba	
	Subalpine fir (*A. lasiocarpa*)		Bl	
Birch		E		
Betula	Paper birch (*B. papyrifera*)		Ep	
Cedar		C		
Thuja	Western redcedar (*T. plicata*)		Cw	
Hemlock		H		
Tsuga	Mountain hemlock (*T. mertensiana*)		Hm	
	Western hemlock (*T. heterophylla*)		Hw	
Pine		P		
Pinus	Lodgepole pine (*P. contorta* var. *latifolia*)		Pl	Pli (interior)
Poplar		A		
Populus	Black cottonwood (*P. balsamifera* ssp. *trichocarpa*)		Ac	Act
	Trembling aspen (*P. tremuloides*)		At	
Spruce		S		
Picea	Black spruce (*P. mariana*)		Sb	
	Engelmann spruce (*P. engelmannii*)		Se	
	Sitka spruce (*P. sitchensis*)		Ss	
	White spruce (*P. glauca*)		Sw	
	Hybrid spruce (unknown origin)		Sx	
	White x Engelmann (Interior)		Sxw	
	White x Sitka (Roche)		Sxs	
	White x Engelmann x Sitka		Sxx	

APPENDIX 3

Glossary

Ah - a surface or near-surface mineral horizon of organic matter accumulation. It contains less than 17% organic carbon. It is one Munsell unit of colour value darker than the layer immediately below, or it has at least 0.5% more organic carbon than the 1C horizon, or both.

alluvial - recent fluvial (see below).

association, plant - an abstract concept comprising all climax stands of vegetation (or plant communities) in which the dominant species of corresponding layers are essentially the same.

available water - the portion of water in a soil that can be readily absorbed by plant roots.

basal till - an unsorted, unstratified mixture of sand, silt, clay, and coarser fragments deposited by ice without additional transportation by water.

biogeoclimatic phase - a significant, extensive area of ecosystems that is, for topographic or topoedaphic reasons, atypical for the regional climate; i.e., a phase reflects local climate.

biogeoclimatic subzone - a subdivision of a zone characterized by a distinct climatic climax or zonal ecosystem association described in terms of vegetation and soil. It consists of unique sequences of geographically related ecosystems in which climatic climax ecosystems are members of the same ecosystem association.

biogeoclimatic variant - a subdivision of a subzone based on differences in regional climate. It is characterized by a distinct zonal ecosystem association plus a supplementary combination of environmental factors (vegetation, soil, ecosystem productivity).

biogeoclimatic zone - a large geographic area that has a broadly homogeneous mesoclimate and exhibits similar patterns of soil and vegetation. It is made up of closely related subzones, and is characterized by a group of closely related, zonal ecosystem associations.

bog - a wetland covered or filled with poorly to moderately decomposed Sphagnum-derived peats. It is strongly acid and low in nutrients.

cemented layer - having a hard, brittle consistence because the particles are held together by cementing substances such as humus, calcium carbonate, or the oxides of silicon, iron, and aluminium.

clay films (skins) - coatings or oriented clays on the surfaces of soil peds and mineral grains, and in soil pores.

climax, types of:

climatic - an equilibrium condition of an ecosystem that reflects the development potential of the mesoclimate or regional climate of an area. It is characterized by a zonal or mesic ecosystem.

edaphic - differs from the climatic climax as a result of overriding soil or substrate conditions.

fire - results from recurrent wildfire.

topographic - reflects the effects of topography on local or microclimate.

coarse fragments - rock or mineral particles greater than 2.0 mm in diameter (includes gravels, cobbles, and stones).

colluvial - unconsolidated materials deposited by mass wasting (direct gravitational action) on or at the base of steep slopes. The materials usually consist of coarse, angular, fractured bedrock, but the bedrock fragments may also be mixed or associated with redistributed glacial till.

community, plant - an area of relatively uniform vegetation. An assemblage of plant populations, forming a system of organisms living together and linked by their effects on one another and their responses to the environment they share.

drift - glacial deposits.

ecosystem - a portion of the landscape and the life on and in it, or a community and its environment treated together. For our purposes, a plant community plus the soil polypedon on which it occurs.

ecosystem association - all ecosystems (land areas plus their biota) capable of producing vegetation belonging to the same plant association at climax.

ecosystem, mesic - the expression of intermediate or medium moisture and nutrient conditions for a particular, geographical area. Synonymous with "zonal" or "climatic climax".

ecosystem phase - a subdivision of an ecosystem association (or sub-association) based on contrasting soil or landform characteristics, such as soil texture, slope classes, aspect, parent materials, bedrock geology, or soil climate.

ecosystem type - all land areas capable of producing vegetation belonging to the same plant association at climax on soil of a single soil family.

ecosystem variation - a subdivision of an ecosystem association used to describe vegetative trends or floristic features that diverge somewhat from the central concept of the association. It may be used to describe successional stages or variation in stand structure, species composition, understory features, etc.

ecosystem, zonal - the ecosystem that best reflects the regional climate. Synonymous with "mesic" and "climatic climax" ecosystem.

edaphic - of or relating to the soil.

edatope - the physical component of an ecosystem; more or less synonymous with habitat.

edatopic grid - a graphic display of the range of moisture and nutrient conditions over which an ecosystem unit or plant develops, with the ecological moisture regime on the vertical axis and the ecological nutrient regime on the horizontal axis.

ericaceous - belonging to the Ericaceae or heather family of flowering plants.

esker - a winding ridge of irregularly stratified sand, gravel, and cobbles deposited under the ice by a rapidly flowing glacial stream.

evapotranspiration - the loss of water from a given area during a specified time by evaporation from the soil surface and by transpiration from the plants.

fabric - the physical constitution of a material, in this case the humus.

fluvial - of or pertaining to rivers; produced by river action, as a fluvial plain.

fluvioglacial (= fluvialglacial, glaciofluvial) - refers to material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

forb - a herb other than a grass, sedge, or other plant with similar foliage.

glacial outwash - stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice.

glacial till - unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

glaciofluvial (= fluvioglacial, fluvialglacial) see "fluvioglacial".

glaciolacustrine - refers to material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice.

gleyed, gleying - a soil-forming process, operating under poor drainage conditions, that results in the reduction of iron and other elements and in gray colours and mottles.

growing degree days - the difference between the mean daily temperature and a selected standard temperature (e.g., 5°C or 10°C), accumulated daily over a period of time such as the growing season or a calendar year.

horizons:

"A" horizon - the uppermost soil horizon; the area of maximum accumulation of organic matter *in situ*; the area of maximum removal of materials by solution, suspension, and erosion.

"B" horizon - the area of accumulation or enrichment of translocated substances organic matter, clay, iron, and aluminum.

"C" horizon - parent material relatively unaffected by major soil-forming processes, except for gleying (Cg) and the accumulation of carbonates and soluble salts.

humus - the complex organic products of the decomposition of plant or animal debris. These materials are more stable than their precursors, and are generally dark in colour, colloidal, and commonly associated with mineral constituents in soil.

kame - a glaciofluvial landform that generally takes the form of a conical, steep-sided hill or short ridge. It is composed of moderately sorted sands or gravels.

lacustrine - refers to material deposited in lake water and later exposed either by lowering of the water level or by uplifting of the land. These sediments range in texture from sands to clays.

marsh - a wetland that is permanently or seasonally inundated with nutrient-rich water, and that supports extensive cover of emergent herbaceous vegetation rooting in mineral-rich substrate.

mesic - intermediate or medium moisture conditions; that is, neither very wet nor very dry. The term refers to habitats that have neither an excess nor a shortage of water, relative to the existing extremes in a given area.

moder - a zoogenous forest humus form made up of plant remains partly disintegrated by the soil fauna (F layer); generally not matted as in mors; mineral grains may permeate organic horizons; insect droppings are common.

mor (raw humus) - a non-zoogenous forest humus form; commonly acidic; distinguished by a matted F layer; fungal mycelia are common.

morainal - refers to materials deposited directly from glacial ice. Sediments are generally compact, non-sorted, and non-stratified and contain a heterogeneous mixture of particle sizes. Fragments are typically slightly rounded to somewhat angular. (Synonymous with "glacial till").

morainal blankets - mantles of morainal material that are greater than 1 m in depth. They are closely associated with long, smooth, bedrock-controlled slopes.

morainal till - non-sorted and non-stratified glacial stony clay accumulated chiefly by the direct action of glacial ice.

morainal veneers - shallow (often discontinuous) mantles of morainal material less than 1 m thick. They occur upslope, on bedrock knobs, or in other locations where bedrock frequently outcrops.

mottling - formation or presence of spots or blotches of different colour or shades of colour interspersed with the dominant colour of the soil.

mull - a zoogenous forest humus form consisting of a mixture of well-humified organic matter and mineral soil that makes a gradual transition to the horizon underneath. It is distinguished by a granular structure. Because of the activity of the burrowing microfauna (mostly earthworms), partly decomposed organic debris does not accumulate as a distinct layer (F layer) as in mor and moder. Found primarily in grasslands.

mycelia - a mass of threadlike filaments, often branched and white or yellow in colour, forming the vegetative structure of a fungus.

orthic - true; of or pertaining to the central concept.

ped - a unit of soil structure such as a block or granule which is formed by natural processes.

pedon - the smallest unit or volume of soil that represents all the horizons of the soil profile. It is usually about one cubic metre, but can be larger.

pH - the degree of acidity or alkalinity of a soil. In forests soils, the pH ranges are:

pH 3-6.9 - Acidic
pH 7.0 - Neutral
pH 7.1-9.0 - Basic

polypedon, soil - a volume of relatively uniform soil; made up of more than one pedon.

potential evapotranspiration (PET) - the evaporation from an extended surface of short green crop that fully shades the ground, exerts little or negligible resistance to the flow of water, and is always well supplied with water. Potential evapotranspiration cannot exceed free water evaporation under the same weather conditions. PET is a function of the amount of solar radiation available, the humidity, and the surrounding air temperature.

seral stage - non-climax, successional stage in the development of an ecosystem.

soil family - a category in the Canadian system of soil classification. Differentiae are primarily texture, drainage, thickness of horizons, permeability, mineralogy, consistence, and soil climate.

soil polypedon - a volume of relatively uniform soil.

solum - the upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

succession, ecological - the progression of ecosystems through time.

successional stage - a step in the progressive development of an ecosystem.

swamp - wooded wetland dominated by 25% or greater cover of trees or tall shrubs, and characterized by periodic flooding and nearly permanent subsurface water flow through various mixtures of mineral sediments and peat. Swamps are rich in minerals and nutrients and with the characteristic water movement, are sufficiently aerated to support either tall shrubs or trees.

terric layer - an unconsolidated mineral substratum underlying organic soil material.

topoedaphic - of or pertaining to a combination of topography and soil.

wetlands - wetlands are lands that are wet enough or inundated frequently enough to develop and support a distinctive natural vegetative cover that is in strong contrast to the adjacent matrix of better-drained lands.

zonal - representative of the mesoclimate or prevailing regional climate of an area. Synonymous with "climatic climax" and "mesic".

SMITHERS-FORT ST. JAMES
ELEVATIONS IN FEET

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SURVEYS AND MAPPING BRANCH
(Joins Finlay River 94 S.W.)

ELEVATIONS IN FEET

CANADA
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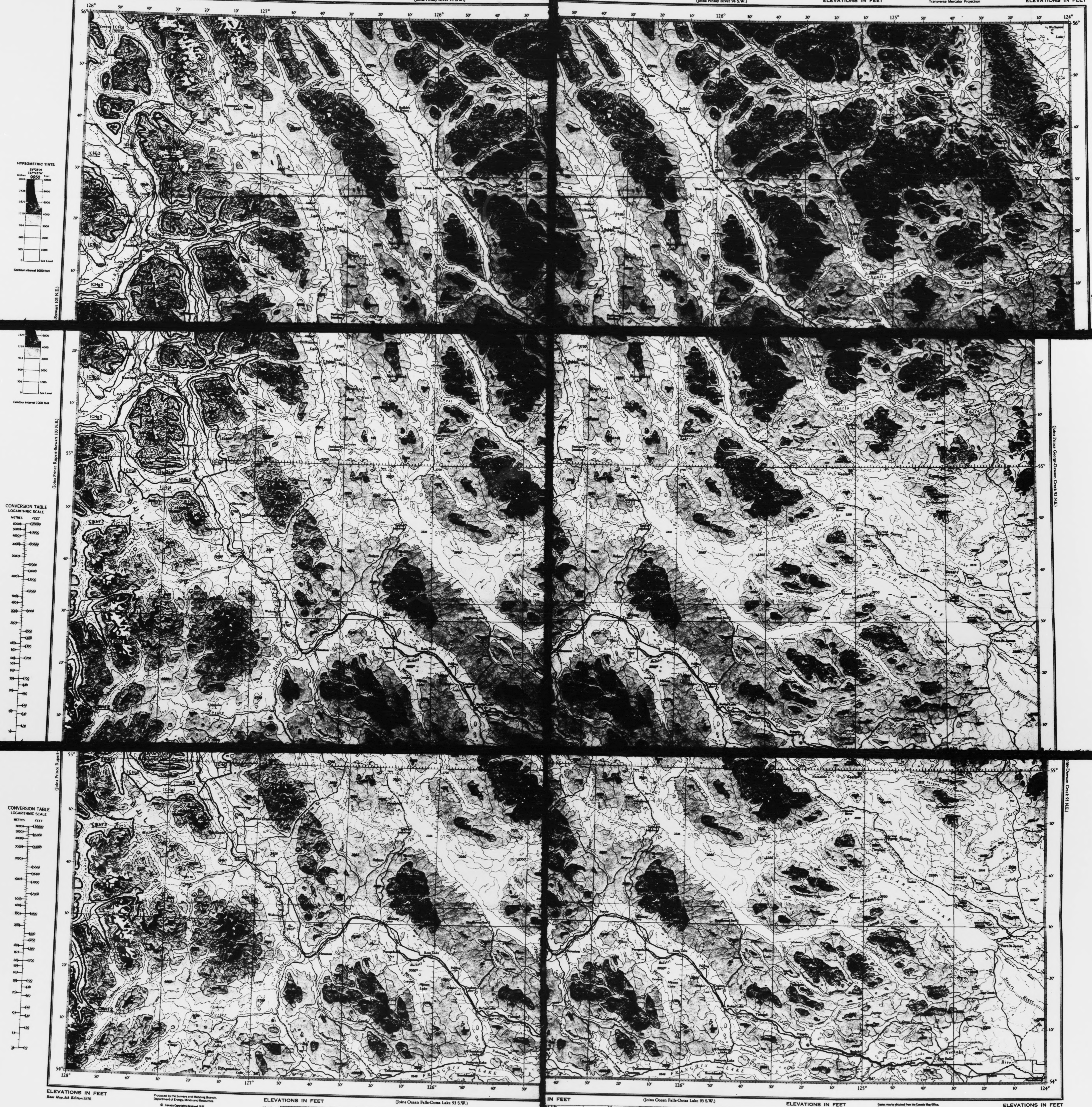
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
(Joins Finlay River 94 S.W.)

Transverse Mercator Projection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Contour interval 1000 feet
CONVERSION TABLE
LOGARITHMIC SCALE
METRES
FEET
FRANÇOIS LAKE
STUART LAKE
Tchesinkut Lake
Fraser Lake
Nechako River

ELEVATIONS IN FEET
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ELEVATIONS IN FEET

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FINLAY RIVER
ELEVATIONS IN FEET

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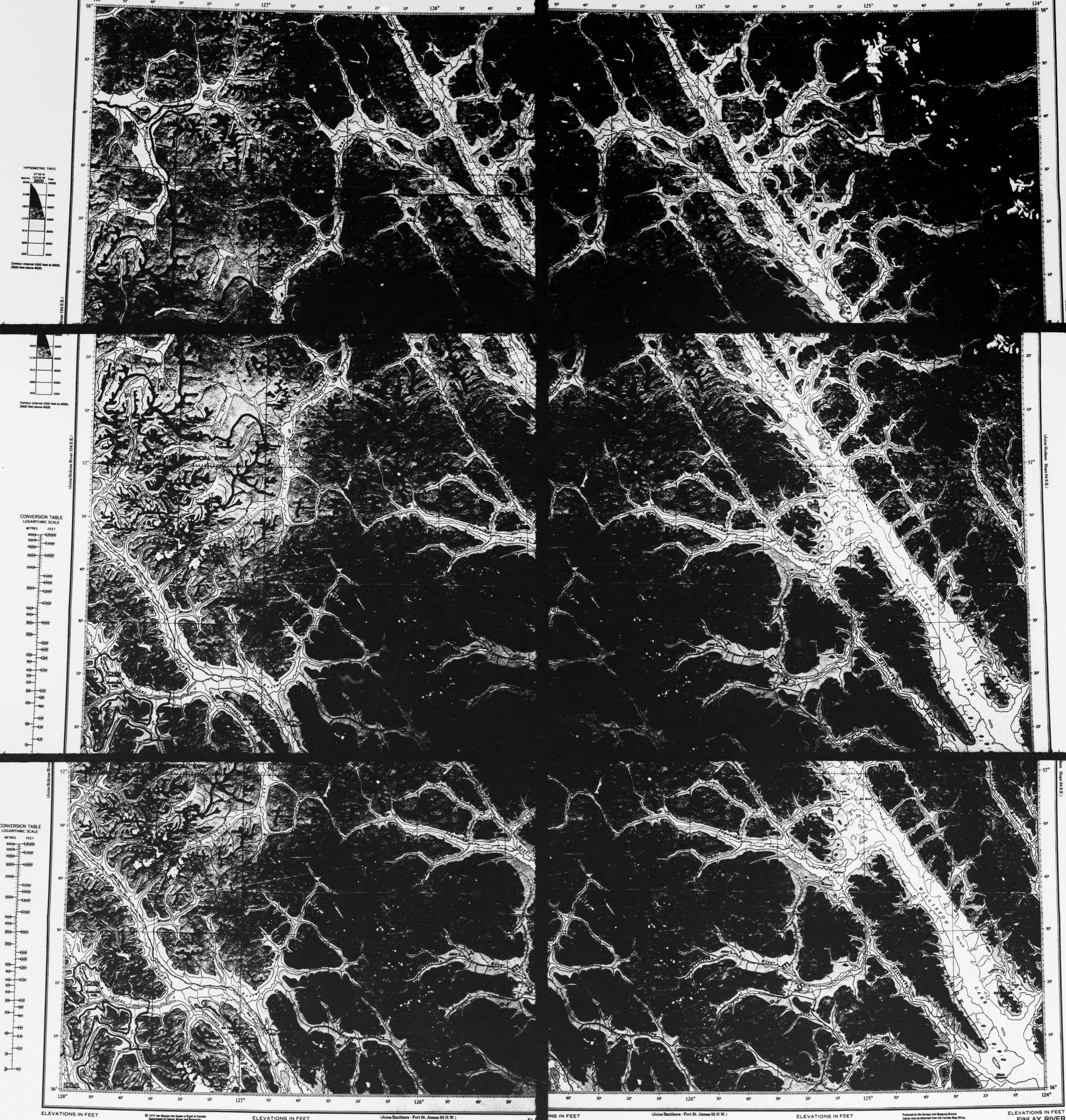
(Joins Liard River 94 N.W.)

ELEVATIONS IN FEET

Transverse Mercator Projection

ELEVATIONS IN FEET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CONVERSION TABLE
LOGARITHMIC SCALE
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(Joins Halfway Hope 94 S.E.)
WILLISTON
LAKE

ELEVATIONS IN FEET

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ELEVATIONS IN FEET

(Joins Smithers - Fort St. James 93 N.W.)

Kilometres 10	0	20	40	60	80	100 Kilometres
Nautical Miles 5	0	10	20	30	40	50 Nautical Miles
Statute Miles 5	0	10	20	30	40	50

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PRINCE RUPERT - STEWART

ELEVATIONS IN FEET

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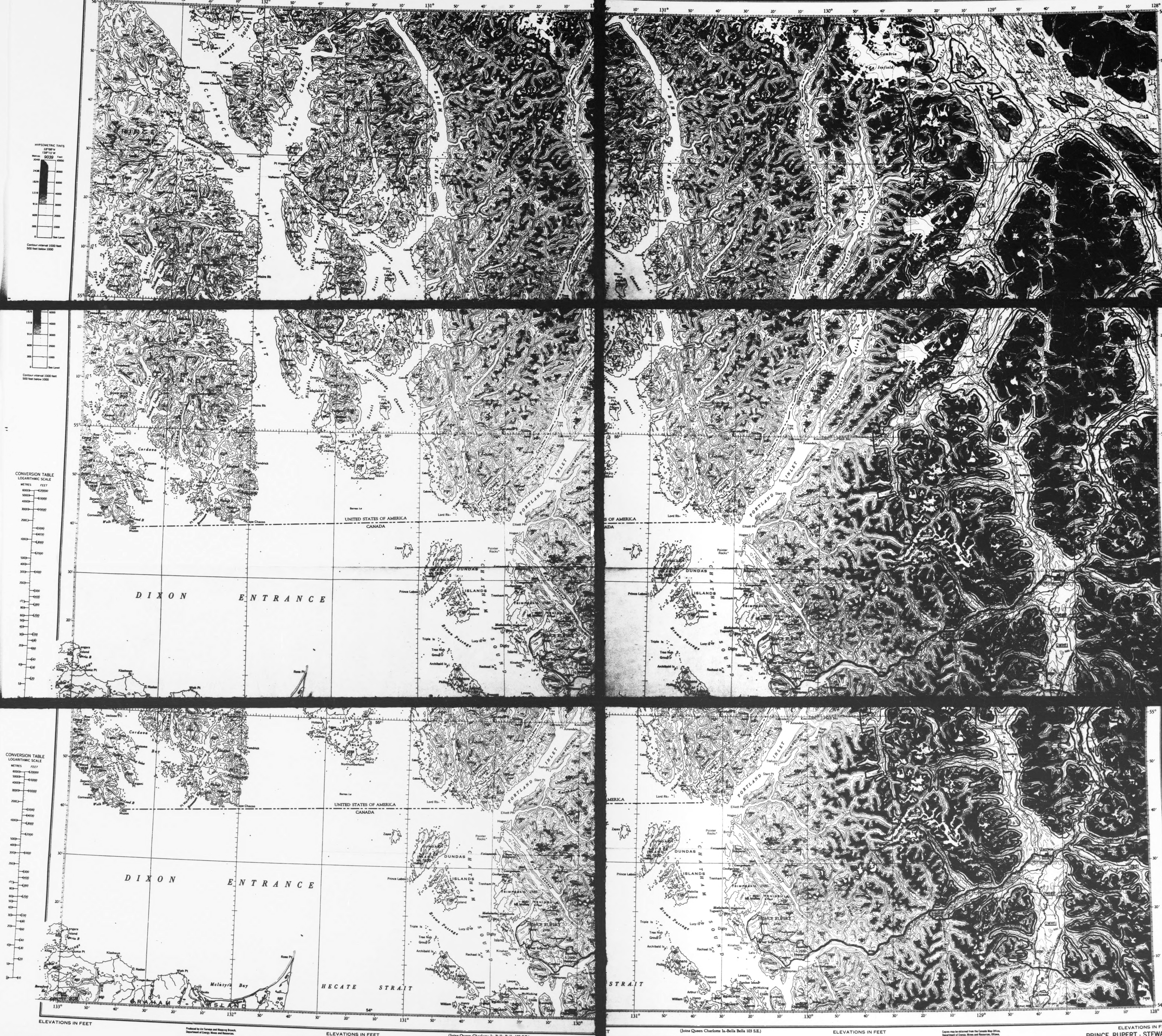
SURVEYS AND MAPPING BRANCH

(Joins Stikine River 104 S.E.)

ELEVATIONS IN FEET

Transverse Mercator Projection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PORTLAND INLET
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DUNDAS ISLANDS
GRAHAM ISLAND
McIntyre Bay
CLARENCE STRAIT
BEHM CANAL
ERNEST SOUND
HYPSOMETRIC TINTS
Contour interval 1000 feet
500 feet below 1000
CONVERSION TABLE
LOGARITHMIC SCALE
METRES
FEET

ELEVATIONS IN FEET

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STIKINE RIVER
ELEVATIONS IN FEET

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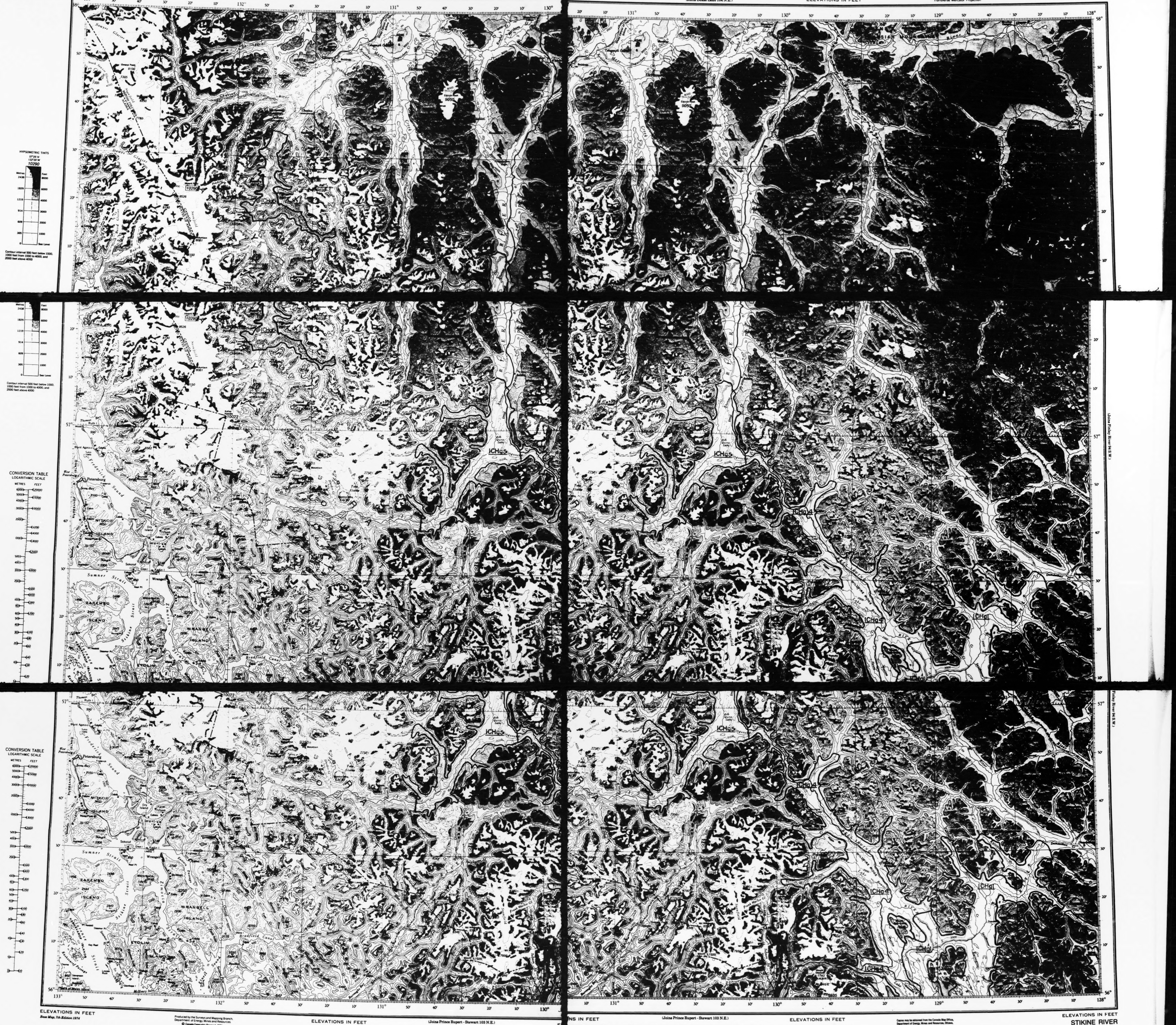
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
(Joins Dease Lake 104 N.E.)

Transverse Mercator Projection


ELEVATIONS IN FEET
HYPSOMETRIC TINTS
Contour interval 500 feet below 1000, 1000 feet from 1000 to 4000, and 2000 feet above 4000
CONVERSION TABLE
LOGARITHMIC SCALE
METRES
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Sumner Strait
ZAREMBO ISLAND
WRANGELL ISLAND
MITKOF ISLAND
Petersburg
Wrangell
ICHg5
ICHg4
ICHg1
(Joins Finlay River 94 S.W.)
133°
132°
131°
130°
129°
128°
58°
57°
56°
50'
40'
30'
20'
10'

ELEVATIONS IN FEET

Base Map, 7th Edition 1974

Produced by the Surveys and Mapping Branch,
Department of Energy, Mines and Resources.
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ELEVATIONS IN FEET

(Joins Prince Rupert - Stewart 103 N.E.)

Kilometres 10 0 20 40 60 80 100 Kilometres
Nautical Miles 5 0 10 20 30 40 50 Nautical Miles
Statute Miles 5 0 10 20 30 40 50 60 Statute Miles

SCALE 1:500,000

(Joins Prince Rupert - Stewart 103 N.E.)

SCALE 1:500,000

Copies may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, or your nearest map dealer.

ELEVATIONS IN FEET
STIKINE RIVER
N.T.S. No. 104 S.E. and part of 104 S.W.